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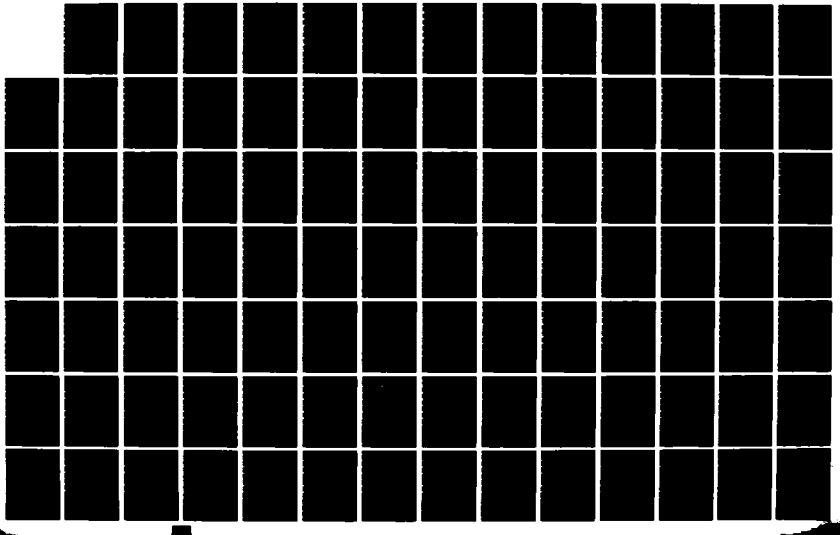

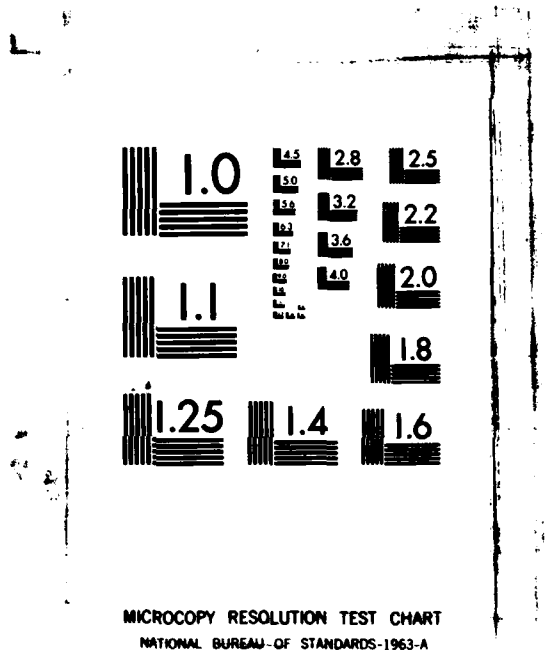
1.0
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MICROCOPY RESOLUTION TEST CHART
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AD-A140 825

DOT/FAA/PM-84/6

Program Engineering &
Maintenance Service
Washington, D.C. 20591

Alternative Voice Switching and Control System Display Panel Format Simulation and Evaluation

M.L. Slonski
J.G. Stipanuk

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

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16. Abstract

This report documents Jet Propulsion Laboratories efforts in the simulation and evaluation of the three alternative displays proposed for the Voice Switching and Control System (VSCS). It includes the identification of the initial display requirements, selection, simulation, and evaluation of the three proposed formats and also the definition and simulation of a final modified display format.

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METRIC CONVERSION FACTORS

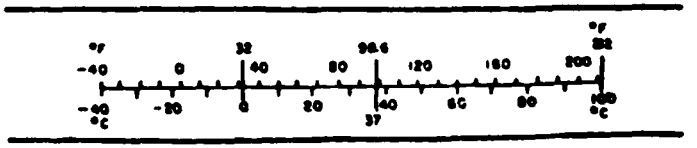
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



60 mph = 52.1 knots (nautical miles per hour)
60 mph = 88'/sec $1g = 32.2'/sec^2$

1 mph = .87 knots
1 knot - 1.15 mph

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SECTION I

INTRODUCTION

A. BACKGROUND

The Voice Switching and Control System (VSCS) Program will implement a voice communications system in Air Route Traffic Control Centers (ARTCCs)/Area Control Facilities (ACFs) that will meet current and future air traffic operational requirements. The VSCS will perform the intercom, interphone, and air-to-ground voice connectivity and control functions. An Operational Requirements Team (ORT) comprising air traffic controllers from each region in the country was assembled to specify the user's requirements and to represent the user's interests during the development of the VSCS. The "Air Traffic Service Operational Requirements" document was prepared on the basis of careful deliberation by the team and is the principal user's input to the VSCS design effort.

Air traffic controllers will access the VSCS communications capabilities through a VSCS display panel that will display air-to-ground and ground-to-ground communications control, facilitate remote equipment selection and operational status reporting, and support air traffic control internal functions. The display panel and information formats contained thereon are the primary interface between the air traffic controllers and the VSCS, and they are critical elements of the VSCS. Although numerous display formats could be used, they must satisfy the air traffic operational requirements, present information in a consistent and logical format, and be easy to use. The planned facility consolidation and equipment standardization require that all VSCS displays be adaptable to varying communication workloads and work assignments and provide for the display of passive information (such as selected frequency, transmitter/receiver sites, or available telephone lines) and active

information (such as status of incoming/outgoing air or ground communications). The integration of the VSCS display panel into sector suite consoles also requires a much more compact display panel than the current communications equipment provides. Because the display panel is so vital to the VSCS, early validation of the user's requirements for the display panel became an important step in the design process. Thus, a realistic simulation of alternative display approaches was pursued as a means to involve the Operational Requirements Team and validate the user's requirements.

B. PURPOSE AND SCOPE

A simulation of display alternatives that represent different arrangements of the required functions and features, given equipment constraints assumed for each alternative, was conducted. The purpose of the simulation was to determine whether or not the implementation of the requirements in terms of the information content and controller actions required for each alternative display panel was consistent with the air traffic controllers' intent. The Operational Requirements Team was convened to evaluate the alternatives and to select a preferred approach. This report documents the entire simulation and evaluation activity which includes the identification of the initial display requirements, selection, simulation and evaluation of three alternative formats, and finally, the definition and simulation of a final modified display format.

C. OBJECTIVES

1. Design Objectives

The challenge facing the VSCS display effort is to design a user-system interface that is easy to use, smaller than the current system, and

achieves flexibility. Simplicity for the users will be introduced by making the format and content of the displays consistent for the different air traffic controller positions and by designing a user-friendly interface that takes into account human factors considerations. Reducing the size will be a major accomplishment. Switches and controls that occupy five square feet of space in today's system must be reduced to an 8 inch by 22 inch display area, or smaller. Finally, a display panel that satisfies the variety of communications capabilities will ensure flexibility to meet changing air traffic needs.

2. Evaluation Objectives

The objectives of the evaluation were to select a preferred display alternative, taking into consideration the ease of executing functions and the ease of observing status, reach agreement with the air traffic controllers participating regarding the modifications and improvements needed, and arrive at a display alternative concept that could be built for a hardware demonstration.

D. APPROACH

A pre-prototype demonstration using a human interface test bed facility was implemented to examine display panel design formats. This approach was selected because it has been demonstrated to be an effective design tool. That is, it allows rapid prototyping and testing of design alternatives without physically building the units. Design iteration and modification can be accomplished in a short period of time and for significantly lower cost than could otherwise be accomplished, and the design can be validated through simulation before it is implemented in hardware.

Three alternative formats were defined to perform the same set of functions, but using three different display devices. The selection of the hardware and formats was based on a review of the operational requirements for the display identified in the "Functional Requirements for Voice Switching and Communications System" and the "Operational Requirements-Voice Switching and Control System" documents, as well as a survey of currently available entry and display devices. The implementation of the three formats was reviewed, iterated, and modified by personnel at JPL and FAA headquarters. The Operational Requirements Team was then convened to systematically evaluate each alternative in terms of ease of executing functions and observing status and, finally, to choose a preferred alternative. Further modifications were suggested and implemented for a final demonstration.

SECTION II

SELECTION OF ALTERNATIVES

A. DISPLAY REQUIREMENTS

The VSCS display panel must fulfill the requirements of the air traffic controllers. The operational requirements that constitute the baseline for the communications display panel were identified and are listed in Table 2-1. The communications functions, user actions, and status functions needed to satisfy the requirements were then specified. Table 2-2 lists the different communications functions that can occur. External actions that will cause a change in status on the display for a position (e.g., incoming ground-to-ground (G/G) calls or receive radio voice) were also identified and are listed in Table 2-3. No communications should be automatically disconnected--it will take an action by the controller at either the calling position or at the called position. Table 2-4 lists the various communications states that are required. For example, the current state of every possible connection must be retained even when it is not visible on the display.

Another requirement is that the display panel must include an indirect access (IA) function, which is used for dialing or for entering special function key codes. For the purposes of the simulation, a pseudo numbering scheme, presented in Table 2-5, was used to demonstrate the required IA functions.

Status indicators used in the display can be either ON or OFF, or they can show various active status states through different blinking rates. The requirements are listed in Table 2-6.

These requirements were used as the basis for selecting the appropriate technologies, for providing the input for designing the format layouts, and to guide the method of implementation. Operational sequences were developed to

Table 2-1. Operational Requirements for VSCS Display Panel

Physical Features

- 8 in. h x 22 in. W x 7 in. d (tentative)
- 4 to 12 radio frequency pairs
- 50 Direct access (DA) pushbuttons

Selection and Other Functions

- Adjustments
  - Brightness for display and indicators
  - Volume control for headset, loudspeaker, chime
- Headset/Loudspeaker
  - Routing for G/G, A/G by frequency
  - Transfer disable for radio
- Main/Standby selection of transmitters/receivers
- Transmit
- Receive
- DA
- IA and IA keypad
- Release
- Hold
- Conference
- Transfer
- Monitor
- Position relief briefing

Status Indicators

- Headset/Loudspeaker transfer disable: OFF, ON
- Emergency frequency in use: OFF, ON
- Main/Standby mode: OFF, ON
- Transmit status: OFF, STEADY, FLUTTER
- Receiver status: OFF, STEADY, SYLLABIC FLUTTER
- Lockout to A/G PTT
- DA: OFF, STEADY, FLASH, FLUTTER, WINK
- Indirect access: OFF, STEADY, FLASH, FLUTTER, WINK
- Incoming override: OFF, STEADY, FLASH
- Conference: OFF, STEADY
- Transfer: OFF, STEADY
- Call forwarding: OFF, ACTIVATED

Table 2-2. VSCS Air and Ground Communication Functions

- Air-to-Ground
  - Transmission on the frequency:
    - Select main/standby transmitter
    - Enable transmission capability
    - Engage push-to-talk (PTT)
    - Free PTT
  - Receiving on the frequency:
    - Select main/standby receiver
    - Enable receive capability by selecting headset (HS) or loudspeaker (LS) for the routing of the received voice
    - External initiation of voice
    - External termination of voice
  - Select BUEC (back-up emergency communications) for both transmitting and receiving on a frequency
  - Emergency frequency signal in-use, not in-use for transmitting or receiving
- Ground-to-Ground
  - Direct access (DA) or indirect access (IA)
    - Initiate
    - Wait for answer
    - Connection made (call answered)
    - Hold call
    - End hold
    - Terminate call
    - Signal receiving of call
    - Connection made (answer call)
    - Placed on hold
    - Released from hold
    - Call terminated
  - Release current connection or function
  - Override call, DA or IA
    - Initiate call with connection made
    - Terminate at initiating position only
    - Signal receiving override call
    - Terminate CANNOT be done by called position
  - Transfer call, DA or IA
    - Initiate transfer function
    - Indicate position to receive the call
    - Connection made
    - Terminate
  - Forward all G/G calls
    - Initiate forward function including position designation
    - Terminate call forwarding
  - Conference call
    - Initiate
    - Successively initiate calls
    - Terminate participation in conference

Table 2-3. VSCS External Actions

	Prompt For
Air-to-Ground	
Start receiving voice	frequency
End receiving voice	frequency
Start emergency frequency in use	121.5 or 243.0
End emergency frequency in use	121.5 or 243.0
End weather dissemination and terminate in 20 seconds	frequency
PTT	--
End PTT	--
Other position PTT with lockout	frequency
End other position PTT with lockout	frequency
Ground-to-Ground	
DA call coming in	DA name
Other party terminates DA call	DA name
Outgoing DA call answered	DA name
IA call coming in	IA name
Other party terminates IA call	IA name
Outgoing IA call answered	IA name
Voice call coming in	from name
Other party terminates voice call	from name
2nd position answers voice call	from name
2nd position terminates voice call	from name

Table 2-4. VSCS Communication States Required

Communication	Characteristics
Radio (24 max)	Selection of main/standby transmitter Selection of main/standby receiver Selection of BUEC transceiver for a frequency pair Transmission enabled/disabled Reception enabled/disabled Selection of HS or LS for receiving voice
DA lines (50 max)	Provide prompt if it requires multidigit dialing to complete the identification of the trunk access Status of inactive, pending (waiting for answer), active (connected), hold, override, conference, transfer, or voice call
IA lines	Status of inactive, pending, active, hold, override, conference, transfer, or voice call

Table 2-5. IA Psuedo Numbering Scheme

Outgoing calls (via IA keypad)

DA	IA - 0 - XX
IA	IA - 4XXX
	IA - 9 - XXX - XXXX
IA(O)	IA - 5XXX

Trunk access calls (via DA)

TA	DA - (msg) - XXX

Trunk access calls (via IA keypad)

TA	IA - 2XXX - (msg) - XXX

(msg :== 'TRUNK READY' in G/G message area)

Special functions

Forwarding	IA - 31 - 0XX
End forwarding	IA - 31 - 000
Transfer	IA - 32 - 4XXX
	IA - 32 - 9 - XXX - XXX
Conference	IA - 33
Posn relief	IA - 34
Brightness	IA - 35 - X
	IA - 36 - X

Table 2-6. Requirements for Status Indicators

Ground-Ground	
OFF	
ON or STEADY	
FLASH	50:50 on-off, 60/minute
WINK	95:5 on-off, 60/minute
FLUTTER	80:20 on-off, 720/minute
Air-Ground	
OFF	
ON or STEADY	
FLUTTER	80:20 on-off, 720/minute
SYLLABIC FLUTTER	assume same as flutter

provide an overview of what may happen in response to the various actions, reflecting the nature of all the preceding requirements, and are presented in the charts that comprise Appendix A.

B. HUMAN FACTORS CONSIDERATIONS

A number of human factors considerations must be incorporated into the design of the display panel. These were reviewed in the literature; they include the effects of color, character size, and spatial parameters.

1. Color

Generally, color should be used when displays are cluttered, when the operation is under a high work load, when redundancy is desired to improve performance, or for future expandability. Color is not recommended when it is not meaningful or when cost is a major consideration. The VSCS display designs are monochromatic and do not include the multiple use of color.

2. Character Size

The size of the display should be as small as possible, but large enough to present the required information without impeding image quality. The

more information displayed, the larger the display should be. The appropriate character size can vary with the type of task to be performed (peripheral searching requires larger characters). An accepted character size standard is 2.6 mm (.102 in.) or 18 minutes of arc (.005236 radians), whichever is greater, assuming the minimum viewing distance of 50 cm (19.7 inches). Expanding this standard to allow for different viewing distances results in the distance-character heights calculated in Table 2-7.

Table 2-7. Calculation of Character Size Standard for Different Viewing Distances

Viewing Distance (inches)	Minimum Character Height[a]
16	.102 in
18	.102
20	.104
22	.115
24	.126
26	.136
28	.147
30	.157

[a]These values have been rounded.

These values are supported in the literature and include allowances for individuals with defective vision.

3. Spatial Parameters

Spatial factors include spacing between elements (smallest discernible detail) and contrast (luminance measure between dark and light). Performance increases with increasing resolution to some ceiling where the element size may be too large. For searching, though, larger elements are more rapidly identified.

C. DISPLAY PANEL SURVEY

A survey of the literature and manufacturers was conducted to evaluate currently available, off-the-shelf display and entry devices. Of primary interest were the human factors aspects. Other criteria that were important were availability, size, response time, and flexibility. No attempt was made to evaluate computer interface requirements, cost, power requirements, cooling requirements, or specific demands for a computer to support the various devices.

1. Display Devices

Eight different technologies for display devices were reviewed. Overall, none were ideal for the application, although two met enough criteria to be considered viable. A comparison of the various technologies based on the evaluation of design variables is presented in Table 2-8. In general, the ECD and EPID devices were found to be still experimental with slow response times, which makes them unsuitable for a VSCS application. LCDs need external lighting and any back lighting of the display may have adverse effects on accuracy in reading the display, which is unacceptable in a VSCS application. LED displays are generally appropriate only in very small applications, and flat CRTs and electroluminescent panels are not yet available from multiple manufacturers. Thus, for this design effort attention was focused on the remaining two technologies, CRT devices and gas plasma panels, as being the most likely candidates for implementation. CRTs that are comparable in both the sizes available and the features provided are available from numerous manufacturers. The one drawback to these devices is that they may be too deep to fit in the space allocated to the display panel. The features and capabilities of the gas plasma panels currently vary considerably by manufacturer,

Table 2-8. Qualitative Comparison of Technologies by Design Variables

Technology	Size	Power/ Voltage	Color Capability	Luminance Capability	Resolution	Dynamic Range	Uniformity	Matrix Addressing	Cost
Cathode-Ray Tube (CRT)	Miniature to large projection	high	yes	low to high	high	yes	fair	yes	low
Flat CRT	small	medium	yes	low to medium	medium	yes	fair to good	yes	high
Light-emitting diode (LED)	small	low	limited	low to very high	high	yes	good	no	low
Electroluminescent (EL)	small to large	medium to high	limited	low to high	high	yes	fair	yes	high
Plasma	small to medium	high	possible	medium	medium	yes	good	yes	high
Liquid Crystal (LCD)	small to medium	low	limited	n/a	medium	yes	good	yes	low to medium
Electrochromic (ECD)	small to medium	low	discrete	n/a	unknown	no	good	no	low
Electrophoretic (EPID)	small to medium	low to high	discrete	n/a	medium	yes	good	probably	low

Source: Snyder, Harry L., (Reference 13)

but it is not a major impediment to this design effort. Their major asset is that they are very thin and might be a promising alternative, but they do not yet have the flexible display characteristics that CRTs have.

2. Entry Devices

The different entry devices reviewed were keypads, push-buttons, and touch panels, which include a variety of technologies. All were considered valid options for the VSCS display design. Touch panels allow the operator to point (touch the desired entry) to choose the menu or activity to be performed. They also enable more selections than are available with pushbuttons. For this design activity, however, all three types of entry device were used.

D. ALTERNATIVES SELECTED

Based on the information obtained from the overview of the technology and of the literature, three alternative devices were selected and formats were developed for simulation and subsequent evaluation. It was judged that many of the possibilities for implementation offered by the variety of technologies reviewed could be tested using three alternatives.

1. Two Touch Panels

This display alternative consists of two touch panel displays, each having the following characteristics:

Overall size	7 in. h x 10.2 in. w x 3.75 in. d
Display area	5 in. h x 8 in. w
Features	12 lines of 40 characters, 5 x 7 dot characters (.21 in. h), underline, inverse video

Figure 2-1 shows the two touch panels; the left panel is used for air-to-ground communications and the right panel is used for ground-to-ground communications. The indirect access functions for this alternative are incorporated into the touch panel for the ground-to-ground communications.

2. CRT With Push-buttons

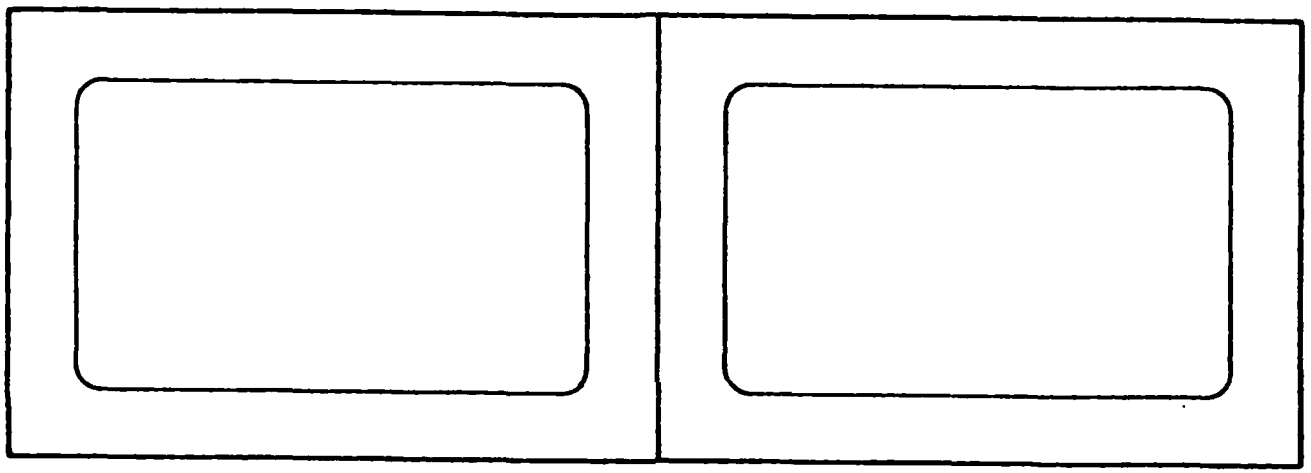
This display alternative consists of a 7 in. CRT with push-buttons on three sides for selection and status reporting. The overall size is 7 in. h x 12.5 in. w x 9.5 in. d. The depth is 1.8 in. greater than the requirement, but further resolution may be possible. The CRT has a white phosphor screen of 16 lines and 32 characters. The illumination of the push-buttons is under computer control. The indirect access functions are implemented as a telephone keypad located on the panel. Both the keypad and the function buttons below it are intended to be back-lit. Figure 2-2 shows the arrangement of the CRT, push-buttons, and keypad. The single CRT screen is used for both air-to-ground and ground-to-ground communications.

3. Two Touch Panels and Keypad

This display alternative consists of two touch panels and a detachable keypad for the indirect access functions. The characteristics of each panel are as follows:

Overall size	7.5 in. h x 12 in. w x 4.3 in. d
Display area	4.13 in. h x 8.25 in. w
Features	16 lines of 64 characters, 7 x 9 dot characters (.138 in. h), graphics, underline, reverse video

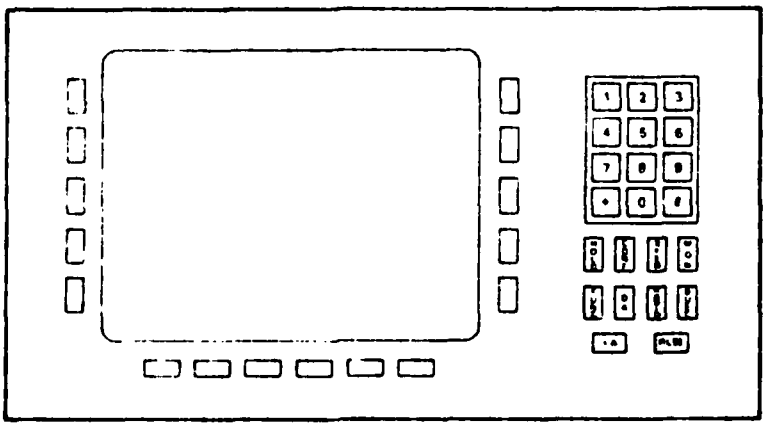
Figure 2-3 shows the panels and keypad. The touch panel on the left is for air-to-ground communications and the panel on the right is for ground-to-ground communications. The overall size of the unit is 28 in. w x 8.5 in. h x 4.6 in. d, which is greater than the requirement. However, this size is based on the standard size currently available; repackaging may be possible.



ESTIMATED DISPLAY SIZE OF 20.4"W x 7"H x 3.75"D

EACH TOUCH PANEL HAS 12 LINES OF 40 CHARACTERS

Figure 2-1. Display Alternative 1: Two Touch Panels



ESTIMATED DISPLAY SIZE OF 12.5"W x 7"H x 9.5"D

THE CRT HAS 16 LINES OF 32 CHARACTERS

Figure 2-2. Display Alternative 2: CRT With Push-buttons

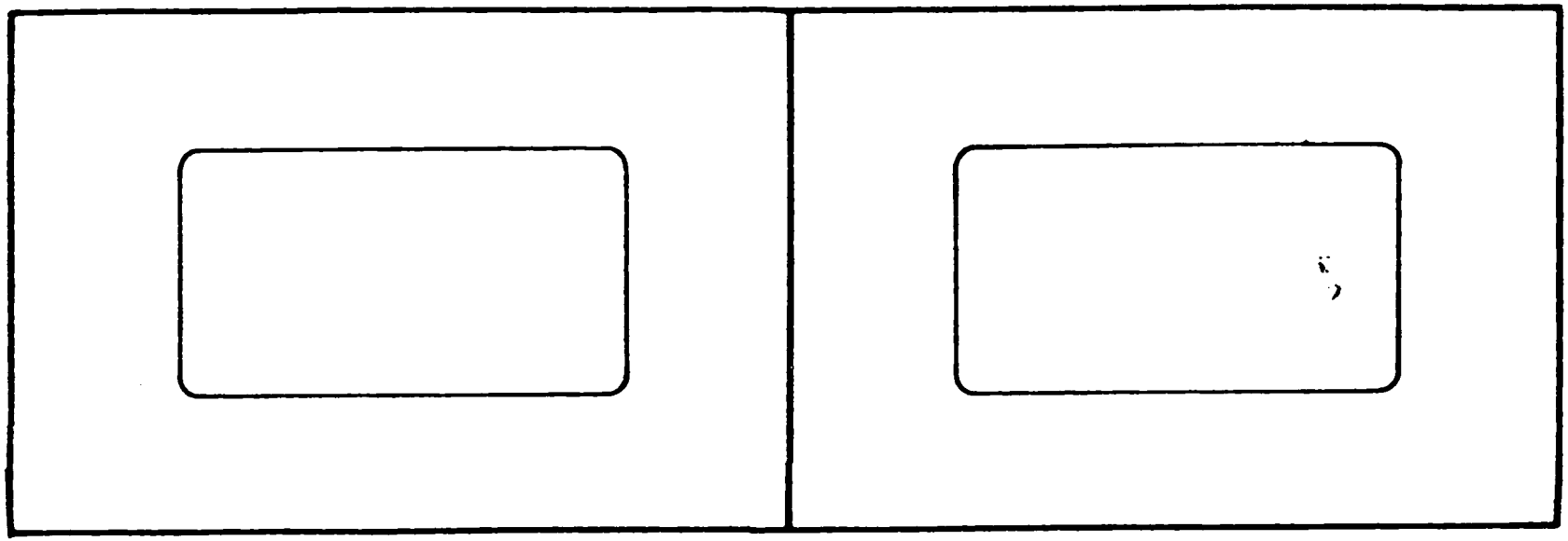


Figure 2-3. Display Alternative 3: Two Touch Panels and Keypad

E. DISPLAY FORMATS

Layouts for possible display formats were developed in an iterative process. First, the user requirements were carefully studied to understand the possible implications for implementation. It was particularly important to understand the operational differences that would affect whether an item was required for permanent display or whether it could be called up when needed. The capabilities of each device type selected for simulation were also carefully studied to understand the possibilities and limitations. During this part of the process, there was frequent interaction with FAA personnel regarding what should be displayed and how it should be displayed.

The next step was to map out different layouts for each device type, keeping in mind the various touch techniques that were required. Of particular importance was the amount of space required for various items to ensure that only a single touch area would be activated at a time. A number of different layouts were attempted and iterated with FAA personnel to reach the final layouts. The detailed diagrams and accompanying narratives for each display alternative are presented in Appendices B, C, and D, for Alternative 1, Alternative 2, and Alternative 3, respectively.

SECTION III

SIMULATION OF ALTERNATIVES

A. HUMAN INTERFACE TEST BED

Human interface design is highly subjective and can reflect the personal experiences and preferences of the designer rather than the needs of the user in a real situation. It is rather straightforward to design a human interface system on paper; however, the large number of options available make it difficult to determine the best design for the specific tasks to be performed. It is also usually very difficult to validate the concept design before the hardware is built, which may be too late to incorporate needed changes at relatively low cost.

The human interface test bed concept has been developed to mitigate some of those difficulties and involve the user at a very early stage in the design. The concept basically relies on highly flexible computer software that functions as a computer-aided design tool for the human interface designer. The software system becomes the basis of a rapid prototyping tool that allows the designer to simulate the hardware capabilities and allows user interaction to validate the design before it is implemented in hardware.

B. METHOD OF IMPLEMENTATION

The three alternative display formats were implemented at a human interface test bed facility using development diagrams and narratives that described the user-system interface. The diagrams were used to provide the spatial (display) information and display frame interrelationships. The narratives were used to script and address the functionality of each display, button, touch area, etc., as well as provide a description of the overall

concept. The narratives were also used as an example of how the user would employ the interface.

Each display format was carefully drawn to show the content and positioning of each entity. The dimensions of the formats were clearly marked and the size of the characters was indicated. Special parameters that pertained to a specific format were also indicated.

Detailed descriptions of the display formats were also prepared to accompany the detailed diagrams. These included information pertaining to each functional area and entity identified in the diagrams. Specific information regarding the use of each function, how each was to be activated, how a response was handled, etc., was also provided.

SECTION IV

EVALUATION OF ALTERNATIVES

A. APPROACH

The Operational Requirements Team was convened to evaluate the three alternative display formats. Evaluation sessions were arranged for the purpose of conducting a structured, objective evaluation of the three alternatives. A major concern was whether or not the order in which the alternatives were viewed and evaluated would affect the outcome. To mitigate the possible bias, the Operational Requirements Team was divided into three groups, with each group evaluating the alternatives in a different order. To evaluate the three alternatives in every posssible order would require six groups. However, it was decided that evaluating the alternatives in the order indicated in Table 4-1 would take care of the concern.

An evaluation methodology and evaluation forms were developed to provide an objective basis for comparing the three alternatives. To accomplish the evaluations, five simulation sessions were conducted. During each session, each individual independently evaluated the alternative using the form provided. Participants were asked not to discuss the alternatives or what they

Table 4-1. Order of Alternatives Evaluated

Group 1:	Alternative 3
	Alternative 1
	Alternative 2
Group 2:	Alternative 1
	Alternative 2
	Alternative 3
Group 3:	Alternative 2
	Alternative 3
	Alternative 1

thought about them until after all the sessions had been completed. The evaluation forms were collected, scored, and analyzed to determine the preferred alternative. Follow-up discussions with the Operational Requirements Team were then held to illuminate and resolve any problem areas or concerns in the preferred alternative.

B. EVALUATION METHODOLOGY

The evaluation focused on whether or not the information presented on the display and the actions required adequately met the requirements of air traffic controllers, and whether or not they would actually use the various functions and features if they had them. The latter was to validate that all the functions and features are requirements.

A list was prepared identifying the specific functions and features that were to be evaluated. The list was divided into three groups, set-up functions, air-to-ground functions, and ground-to-ground functions, and is presented in Table 4-2. Each alternative was evaluated for exactly the same functions and features.

1. Function Weights

The basic approach of the evaluation was centered around the list of functions and features. The first step was to weight the relative importance of the functions and features on the list in terms of how often it is used or how critical it is to access the function immediately. For each function, the function weight (W_f) indicates the relative importance of that function, regardless of the alternative. The weighting was done before the display format simulations were viewed. It was recognized that all the items on the list were derived from operational requirements specified by the

Table 4-2. Functions and Features to be Evaluated

Set-Up Functions
Position relief
Routing of voice (A/G, G/G, and override)
Volume control (headsets, loudspeakers, chime)
Display brightness control
Ground-to-Ground Functions
Direct access calls
- Override
- Non-override
Indirect access calls
Common answer queue call selection
Release
Hold
Transfer
Monitoring
Conference
Air-to-Ground Functions
Transmit
- Enable
- Select main/standby
Receive
- Enable
- Select main/standby
- Route voice to headset or loudspeaker
Site selection
BUEC
Emergency frequencies
Weather dissemination
Automatic transfer to loudspeaker

Operational Requirements Team, which implies that they are important to air traffic controllers. However, the intent was to validate the requirements and define relative priorities that would facilitate the design of the display format. Thus, weighting matrices were formulated. The Operational Requirements Team was instructed to check the relative importance of each function and feature. The scale used ranged from "very important" (5) to "not at all important" (1). The matrices that were used are included in Appendix E.

2. Function Ratings

The display demonstration used in the evaluation sessions corresponded to the three groups of functions, set-up, ground-to-ground, and air to ground, and the evaluation was based on how adequate each display was in terms of using the function on the job. For each function, the function rating (R_f) indicates the function's adequacy or how well a particular alternative performed that function. The rating scale ranged from "very adequate" (5) to "not at all adequate" (1), and included a special column to indicate if a function was "totally unacceptable".

Several questions were included pertaining to how easy it seemed to use the functions and comments were solicited. The evaluation forms were identical for each alternative and are reproduced in Appendix E.

3. Figure of Merit

The scoring approach consisted of determining a figure of merit (FOM) for each alternative, for each individual participating in the evaluation.

For each individual:

$$FOM = \sum_{f} W_f \, R_{f,i} \qquad \text{for } i = \text{Alternative 1, 2, and 3}$$

The alternative with the highest figure of merit score was the preferred alternative. Functions marked "totally unacceptable" were treated as zero in the figure of merit score, but they were also noted as problem areas and were discussed separately in the follow-up session.

In addition to scoring each alternative for each individual, three group average figure of merit scores were obtained for each alternative. The group breakdowns were for the total group, for the subgroup that comprised air traffic controllers with en route experience, and for the subgroup with terminal experience. These breakdowns were done to determine if the differences in requirements for the two different types of facilities affected the outcome of the evaluation.

The comments and questions in the form were reviewed and analyzed to obtain additional information pertaining to the display design and to facilitate the follow-up discussions that were held.

C. RESULTS

1. Ranking of Alternatives

The outcome of the evaluation was the same for the group as a whole, for the subgroups, and for each individual. Alternative 3, two touch panels and moveable keypad, was ranked first; Alternative 1, two touch panels, was ranked second, and Alternative 2, CRT with push-buttons, was ranked third. The unanimous outcome would indicate that there was no bias attributable to the order in which the simulations were observed. The figure of merit scores for the group and subgroups are listed in Table 4-3, and for the individuals in Table 4-4.

Table 4-3. Group Average Figure of Merit Scores

	Alternative 1	Alternative 2	Alternative 3
Overall Group	364.1	277.1	392.2
Terminal Experience Group	401.0	303.5	406.5
En Route Experience Group	343.0	270.3	385.4

Table 4-4. Individual Figure of Merit Scores

	Alternative 1	Alternative 2	Alternative 3
1	267	229	300[a]
2	320[a]	243[a]	345[a]
3	342	216	360
4	348	323	370
5	336[a]	295	383
6	341	272[a]	397[a]
7	-	263	411[a]
8	472	401	481
9	441	322	503

[a]Some functions "totally unacceptable".

The statistical values for the group scores are included in Appendix F. Each alternative had some functions that were totally unacceptable, indicating that some adjustments had to be incorporated.

2. Problem Areas

Problem areas were identified for each alternative and were presented to the Operational Requirements Team to facilitate discussions concerning modifications to be made to the preferred choice. Problem areas were defined to include not only those functions marked totally unacceptable, but also those functions that individuals had indicated were either "very important" or "quite important" when they weighted them, and were subsequently scored by the individual as "not very adequate" or "not at all adequate" for the alternative.

The problem areas identified for Alternative 3, presented in Figure 4-1, were fewer than for the other alternatives (included in Appendix F); this is consistent with its being the preferred choice. For the set-up functions, two items were considered problem areas, voice routing and volume control. First, regarding the routing of voice, some thought that incoming ground-to-ground calls should not kick air-to-ground calls to the loudspeaker. This would occur only if the auto loudspeaker feature was selected, and one could choose to select it or not. Thus, it is not really a problem. The implementation of the volume control had several problems. First, it was generally held that the volume control should not even be on the display, but rather, on the headset or loudspeaker to be controlled. Also, the controllers preferred continuous or dynamic, rather than discrete, adjustments for both the volume and brightness controls.

For the ground-to-ground functions three items were considered problem areas. First, the release function was indicated as a problem area because it was not in a convenient location on the display panel. Some controllers suggested that the release feature could be located on the IA keypad, while other controllers wanted it on the display panel as well as on the keypad. Second,

SET-UP FUNCTIONS

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
POSITION RELIEF							
ROUTING OF VOICE (A/G, G/G AND OVERRIDE)					X		
VOLUME CONTROL (HEAD-SETS, LOUDSPEAKERS, CHIME)				X			X
DISPLAY BRIGHTNESS CONTROL							

GROUND-TO-GROUND FUNCTIONS

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
DIRECT ACCESS CALLS							
- OVERRIDE							
- NON-OVERRIDE							
INDIRECT ACCESS CALLS							
COMMON ANSWER QUEUE CALL SELECTION							
RELEASE				X			
HOLD							
TRANSFER							
MONITORING				XX			
CONFERENCE				X			

AIR-TO-GROUND FUNCTIONS

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
TRANSMIT							
ENABLE							
SELECT MAIN/STANDBY							
RECEIVE							
ENABLE							
SELECT MAIN/STANDBY							
ROUTE VOICE TO HEAD-SET OR LOUDSPEAKER							
SITE SELECTION							
BUDC				X			XX
EMERGENCY FREQUENCIES				X			
WEATHER DISSEMINATION							
AUTOMATIC TRANSFER TO LOUDSPEAKER							X

Figure 4-1. Alternative 3 - Problem Areas

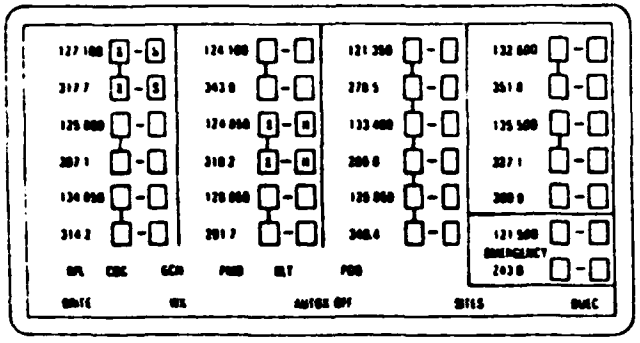
the monitor function required the selection of the function plus the entering of a code using the keypad to indicate the location to be monitored. The controllers did not want to have to enter a code, but rather would prefer to select the position to be monitored using the DA function. Finally, some of the controllers argued that the conference function was not needed at all.

Three problem areas were identified for the air-to-ground functions. The BUEC function, and whether or not it was part of the VSCS, raised considerable discussion. The BUEC question is not yet resolved and the controllers decided that it was beyond the scope of their involvement and would have to be resolved elsewhere. The implementation of the emergency frequencies was that they were always on; this was indicated as a problem because the controllers wanted to be able to turn them off. The final problem area was the automatic transfer to loudspeaker, which was the same issue as was raised for the routing of voice in the set-up functions. As previously explained, once the controllers understood how this feature worked, they recognized that it was not a problem.

3. Conclusions

The final outcome of the evaluation was the unanimous choice of Alternative 3, with slight modifications to alleviate the problem areas, as the preferred display format. In addition to the problems identified in the analysis, the follow-up discussions illuminated a number of other enhancements that could be incorporated into the display rather easily. Thus, the evaluation resulted in the development of a modified alternative that was subsequently implemented in the test bed facility. The display formats for the modified alternative are presented in Figure 4-2 and the specific details for the implementation are included in Appendix G. The final, modified alternative was video taped to preserve the functions and their use for future demonstration.

Air-to-Ground



Ground-to-Ground

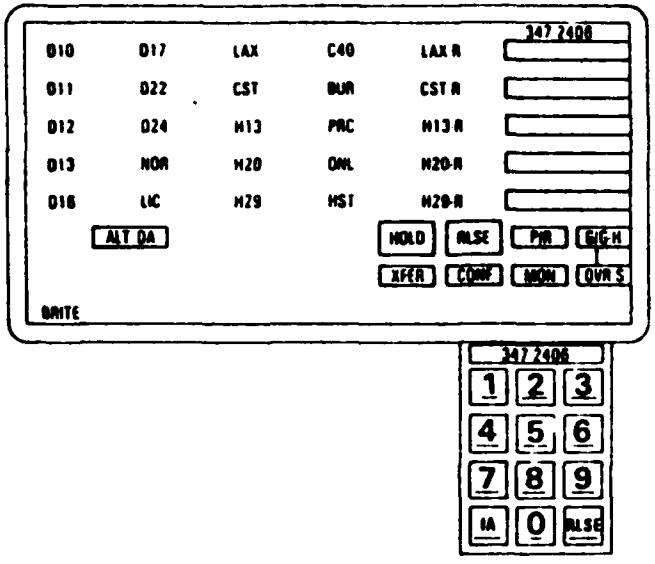


Figure 4-2. Modified Alternative

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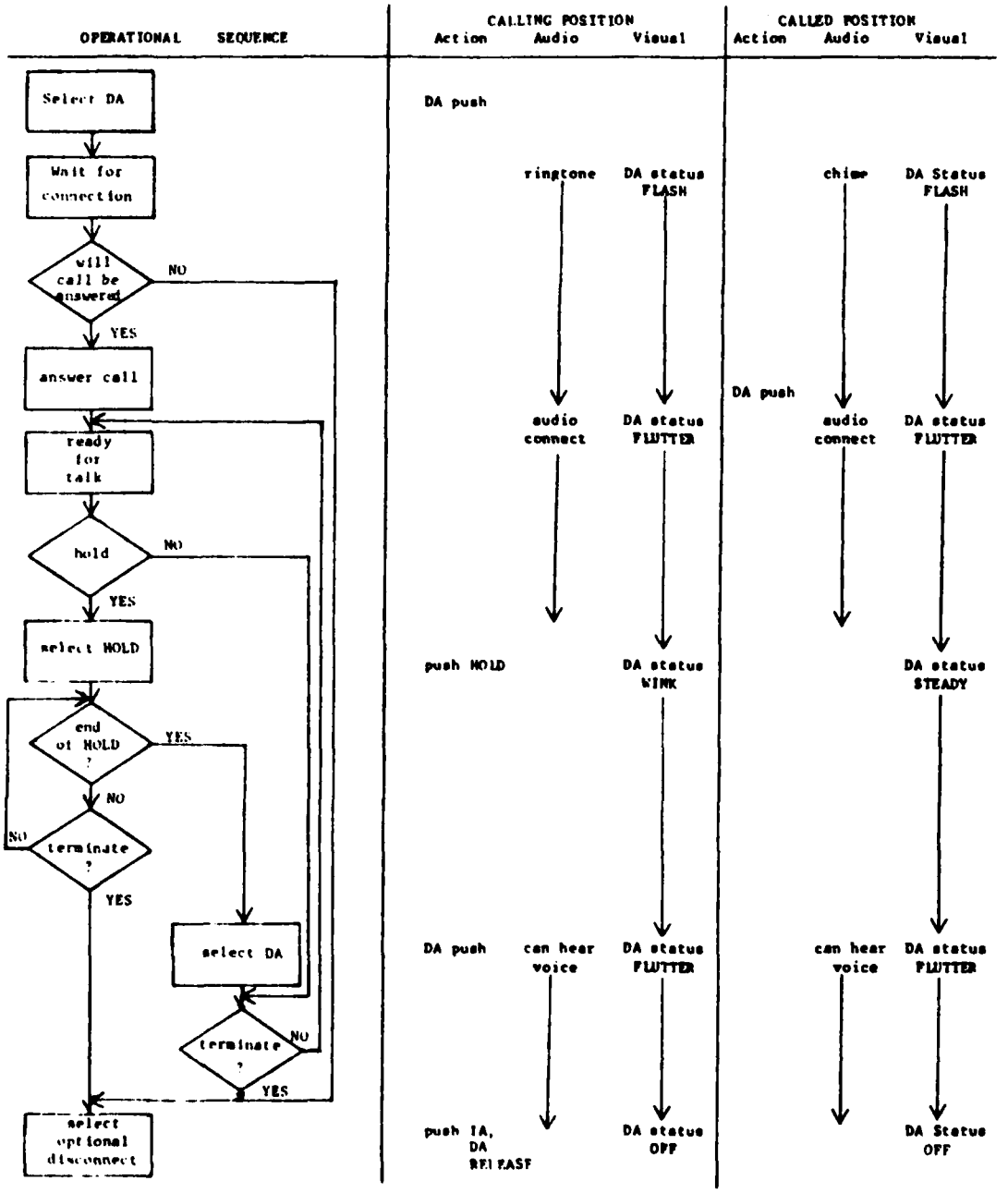
APPENDIX A

OPERATIONAL SEQUENCES FOR VSCS FUNCTIONS

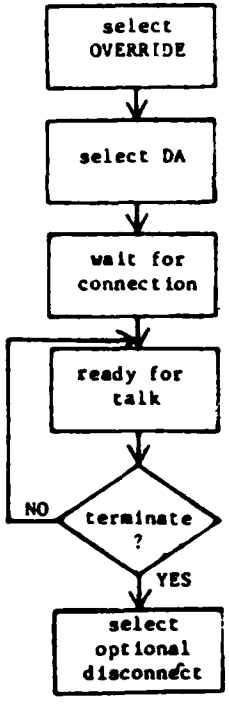
VSCS FUNCTION: DIRECT ACCESS CALL: INITIATE, HOLD, TERMINATE

ASSUMPTIONS: 1. Connection will exist at both ends (otherwise use CA at called position)
2. Caller initiates hold



VSCS FUNCTION: DIRECT ACCESS OVERRIDE CALL

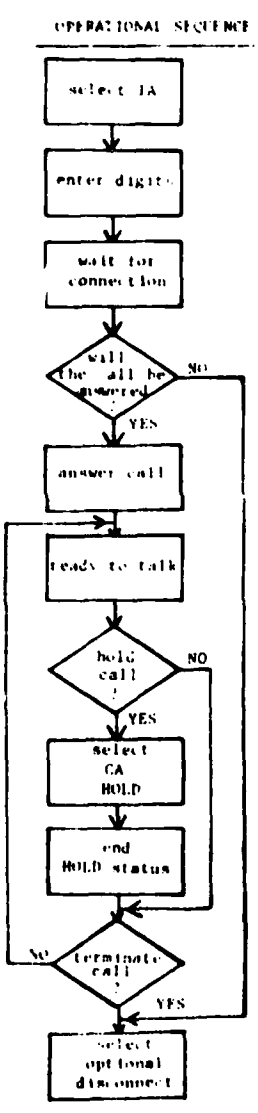
ASSUMPTIONS:
1. Connection will exist at both ends
2. Only calling position can disconnect
3. No automatic override feature at this position



OPERATIONAL SEQUENCE	CALLING POSITION Action	Audio	Visual	CALLED POSITION Action	Audio	Visual
select OVERRIDE	push OVERRIDE		OVERRIDE ON			
select DA	push DA					
wait for connection		ZIP	DA status FLUTTER		ZIP	DA status FLUTTER; OVERRIDE in status ON
ready for talk		audio connect			audio connect	
terminate ? NO						
terminate ? YES						
select optional disconnect	push DA, IA, RELEASE		DA status OFF; OVERRIDE OFF			DA status OFF; OVERRIDE in status OFF

VSCS FUNCTION INDIRECT ACCESS CALL: INITIATE, HOLD, TERMINATE

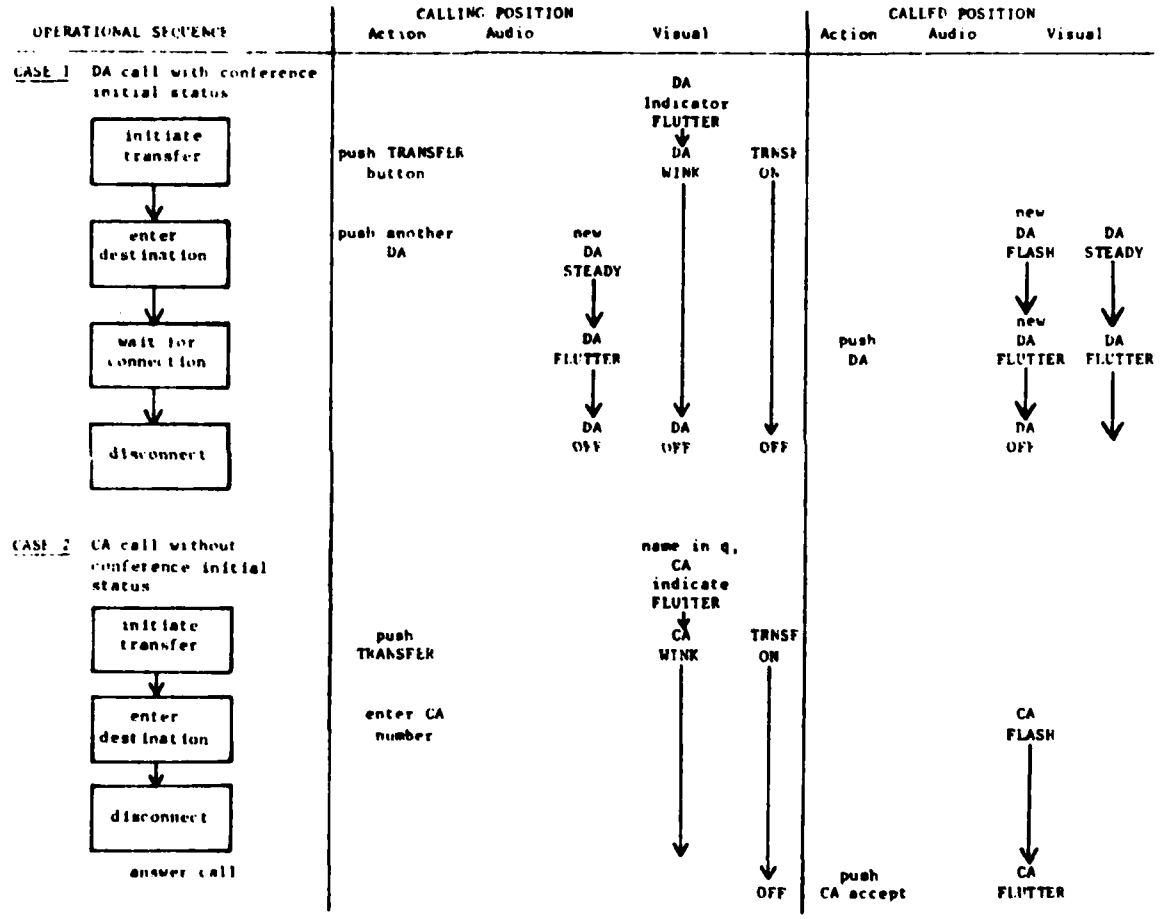
ASSUMPTIONS.
1. Connection will exist at both ends
2. Caller initiates hold
3. CA queue never has more than one call



OPERATIONAL SEQUENCE	CALLING POSITION Action	Audio	Visual			CALLED POSITION Action	Audio	Visual		
	push IA	dial tone	IA FLASH							
	push keypad digits	momentary DTMF signal tones			display digits as entered or call ID					
		ringtone					chime	CA status FLASH		display caller in CA q
						push CA select				
		voice connect	IA FLUTTER				voice connect	CA status FLUTTER		
	push HOLD		IA STEADY	HOLD WINK	digits w HOLD indication				HOLD WINK	CA Steady	digits w hold indic.
	Select HOLD number in queue	Voice connect	IA FLUTTER	HOLD OFF	remove HOLD indicat.		Voice connect		HOLD OFF	CA FLUTTER	digits w/o HOLD
	Push IA, DA, RELEASE		IA OFF		remove digits from CA q					CA OFF	remove digits from CA q

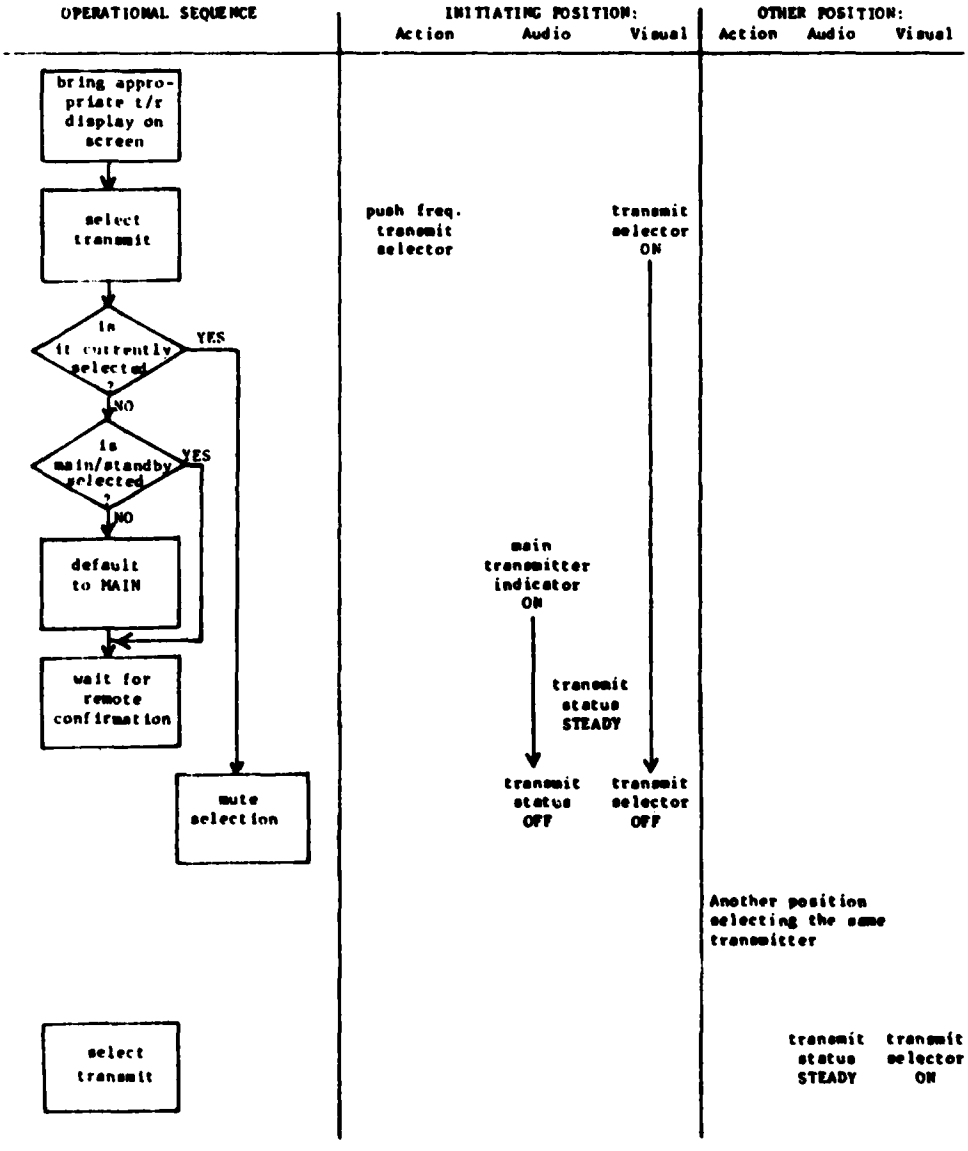
VSCS FUNCTION: TRANSFER ACTIVE CALL

ASSUMPTIONS: 1. All connections will be made



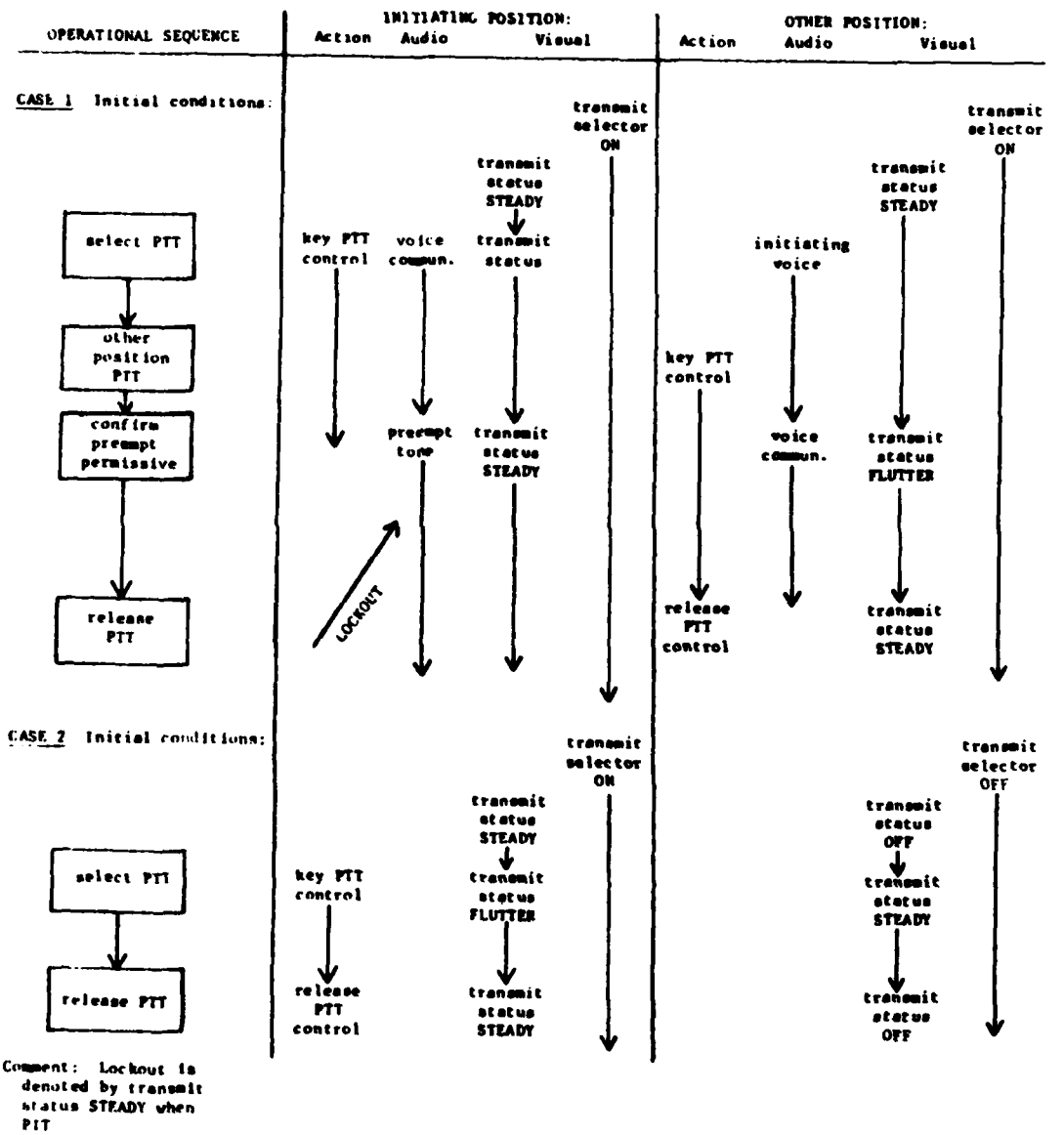
VSCS FUNCTION: RADIO TRANSMITTER/RECEIVER SELECT

ASSUMPTIONS:
1. Receive logic is same as transmit logic
2. Remote connectivity is established
3. If main/standby NOT previously selected, default to main



VSCS FUNCTION: RADIO PUSH-TO-TALK/PREEMPTION/LOCKOUT

ASSUMPTIONS: 1. Transmitter keying control signal received and confirmed
2. Main/standby transmitter selected



Comment: Lockout is denoted by transmit status STEADY when PIT

APPENDIX B

DISPLAY ALTERNATIVE 1 FORMATS

GENERAL COMMENTS

1. When "IA" is touched, change it from normal video to reverse video to indicate keypad entry required. When the entry is complete (or terminated), return the "IA" to normal video.

2. The chime level can go to zero (off).

3. Follow the guidelines below for the use of emergency frequencies (121.500 and 243.0).
   a. Use a default of receiver on, headset selected. These frequencies can alternate between headset and loudspeaker, but the receive function cannot be turned off.
   b. There are no MAIN/STANDBY indications and the frequency numbers are not valid touch areas.
   c. The headset or loudspeaker indicator for the desired frequency will flutter whenever voice is being received, just as with any other frequency.
   d. Enabling transmission
      - tx, when off, will be turned on by touching the tx bar for the desired emergency frequency.
      - tx selected is indicated by an "*" placed in the indicator bar in line with the frequency.
      - PTT with tx selected will flutter the tx indicator bar ("*" normal and reverse video).
      - no PTT or rx within 10 seconds will automatically turn off the tx capability (i.e. return the frequency to normal video and turn off the tx indicator bar).
      - when tx is selected, touching the "*" will turn tx off.

4. Follow the instructions below for weather dissemination.
   a. Touch WX. It will be displayed in reverse video and will flutter in reverse video for 20 seconds to simulate the weather message being transmitted. All frequencies with tx enabled will flutter their indicator area also.
   b. If PTT or rx is activated during this process, either at this position or at another position which also has a frequency selected for tx, turn off all weather transmissions.

5. Releasing an active call means
   a. another party terminates the currently active call (except voice calls or incoming override).
   b. a new call is initiated via DA or IA.
   c. RLSE is touched.
   d. Unless processing a conference call, there can only be one active call at a time.

6. Do not display a site for emergency frequencies.

7. When tx is selected, automatically enable rx. If rx is deselected, automatically deselect tx.

8. Make the STANDBY underline indicator more distinct from the MAIN indicator.

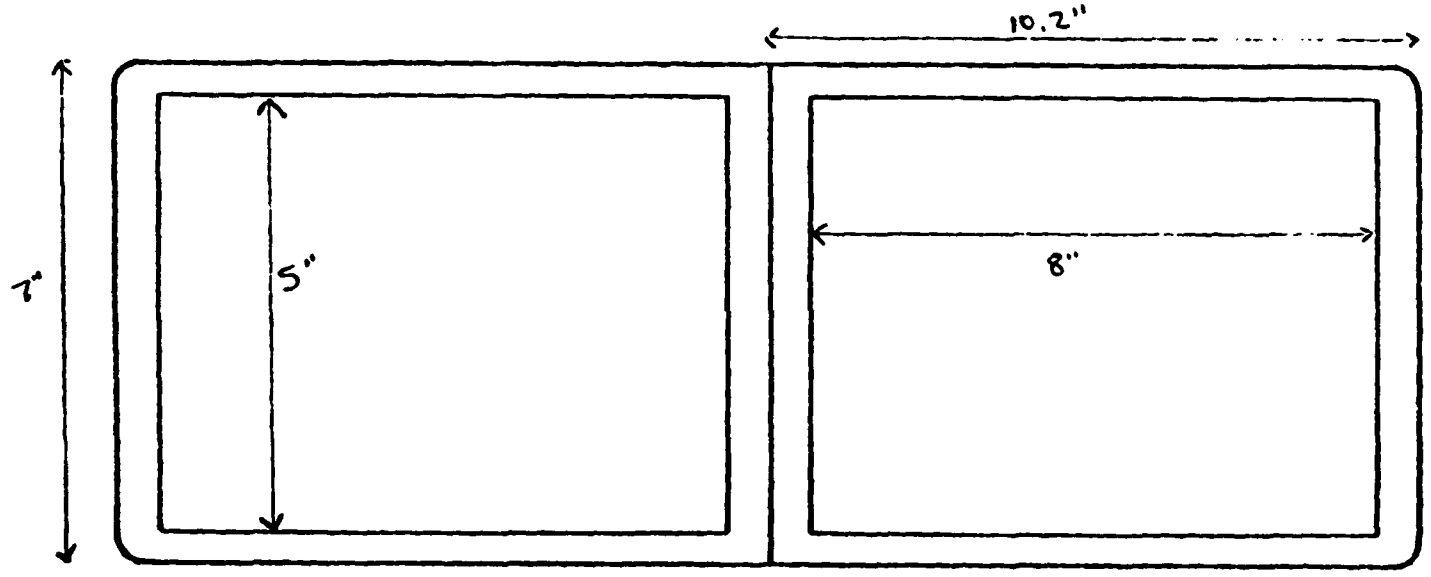
9. There should be an indication message when the position relief recording is in progress. This message may be temporarily interrupted when displaying other messages.

10. There should be no underlining when changing a BUEC selected tx/rx from headset to loudspeaker and vice versa.

11. Use "RLSE" on both displays instead of "RLS".

VSCS DISPLAY ALTERNATIVE: TWO TOUCH PANELS

ALTERNATIVE 1



ESTIMATED DISPLAY SIZE OF 20.4"W x 7"H x 3.75"D
EACH TOUCH PANEL HAS 12 LINES OF 40 CHARACTERS

V0026
Y0006

Alternative 1.

Note. Alternative 3 functions similarly to Alternative 1, especially for the a/g display.

A/G

1. When initialized
   -frequency pair 127.100/317.7 will have tx enabled on main transmitters and rx enabled on main receivers and headset designated.
   -defaults for other frequencies are MAIN tx/rx and headset but are not enabled initially
2. MAIN/STANDBY
   same logic as previously described (main=solid underline and standby=broken underline).
3. Transmit
   -tx indicator bar needs a line drawn across the middle to distinguish the frequencies more. Also, each half (top/botton) of the tx bar will behave separately according to activity on the associated frequency.
   -tx enabled is indicated by a '*' in the box area next to the frequency and the main/standby indication is given.
   -assuming neither frequency in the pair has tx or rx enabled, select tx by touching the tx bar and both frequencies will have the tx capability enabled (main/standby indicators shown) and the current H or L displayed in both rx boxes.
   -deselect the tx capability for a specific frequency by touching the corresponding '*' in the tx bar. The tx main/standby indication will disappear for that frequency with rx unaltered.
   -enable tx again by touching the tx bar for that frequency
4. Receive
   -rx enabled is indicated by a H or L in the box corresponding to that frequency. When not enabled, the box will be empty.
   -select rx by touching the blank rx box. An H or L will be displayed corresponding to the curren H/L definition for the frequency. Both VHF and UHF frequencies MUST have the same indication of H or L. For example,

	VHF	UHF
both rx off	blank	blank
both rx on H	H	H
turn off UHF	H	blank
change VHF	L	blank
turn on UHF	L	L

   -one touch to an rx box that is enabled (has H or L) will toggle that frequency pair between H and L
   -rx is turned off at a frequency by two(2) rapid touches to the rx box

5. Presence of voice
   -TRANSMIT

this posn tx	this posn PTT	other posn tx	other posn PTT	this position tx indicator bar
not sel	off	select	on	flutter blank/orange
not sel	off	select	off	black
select	off	select	off	* in normal video
select	on	select	off	flutter * with reverse video
select	off	select	on	if lockout, solid reverse *

   -RECEIVE

this posn rx	this posn voice	this position rx indicator bar
not sel	no	blank
not sel	yes	flutter black/orange
select	no	H or L in normal video
select	yes	flutter H/L with reverse

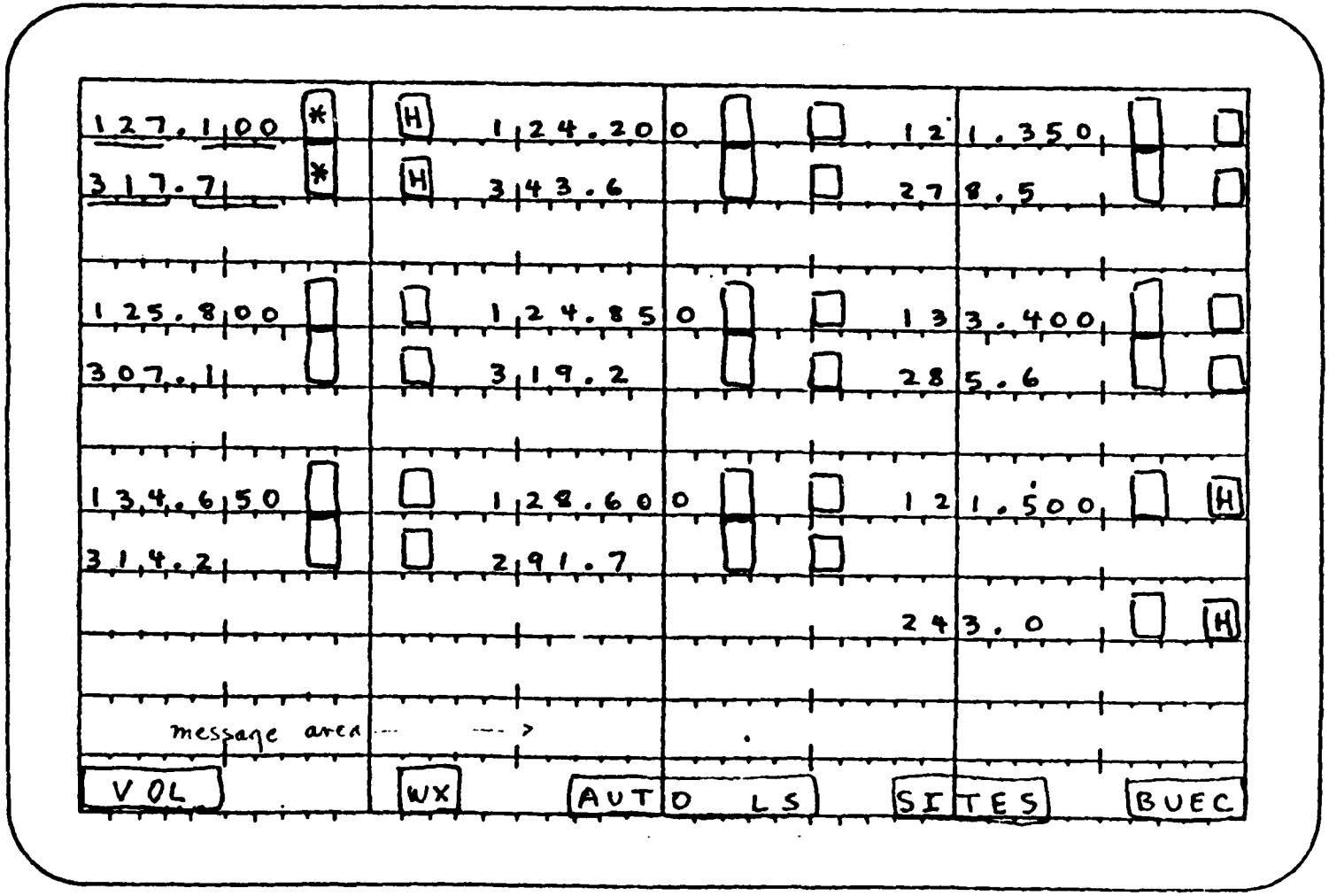
   -WEATHER
   20 second flutter of all tx enabled frequencies and WX (normal/reverse). If tx or rx voice appears at any frequency, end all WX transmissions and return WX to normal video.
   -BUEC
   Touch BUEC and it goes to reverse video. Touch a frequency and BUEC returns to normal video and the frequency's tx and rx indicators will be displayed in reverse video and will not show status change with presence of voice. Rx can be changed between H and L but cannot be turned off. BUEC is disabled when tx is again selected.
7. 'AUTO LS' and 'AUTO OFF' toggle. When LS is set and there is g/g voice in the headset (i.e. g/g-H selected and there is an active DA or IA call), any radio rx will temporarily be routed to L instead of H until the g/g voice stops. The radio rx indicator will then automatically return to its original H state.
8. Sites.
   There are no changes in the way the site logic functions. However, when sites are displayed, change 'SITES' to 'RADIO'. When 'RADIO' is touched, return to the radio display. The tx/rx indicators are unaffected by this display.
9. VOL
   Touch this area to adjust (or view) headset/loudspeaker volume settings (Drawings 1a and 1b). The new 'DWN' area will toggle with ' UP' to increment settings downward or upward as the boxes are touched.
   Touch VOL again to erase these areas from viewing. This display section may stay in view without problems and can be turned off at any time.

G/G
1. This display (Drawing 2a) functions as before but some of the special function buttons must be called up using the 'FUNC' touch area.
2. The bottom line contains the DA group pages and 'FUNC'. The current page that is being displayed will have its name cleared (blanks) from its box. Any other group with

an active call (or special function in effect) will appear with its name in reverse video. Any DA group with a call waiting to be answered will appear in flashing reverse video.

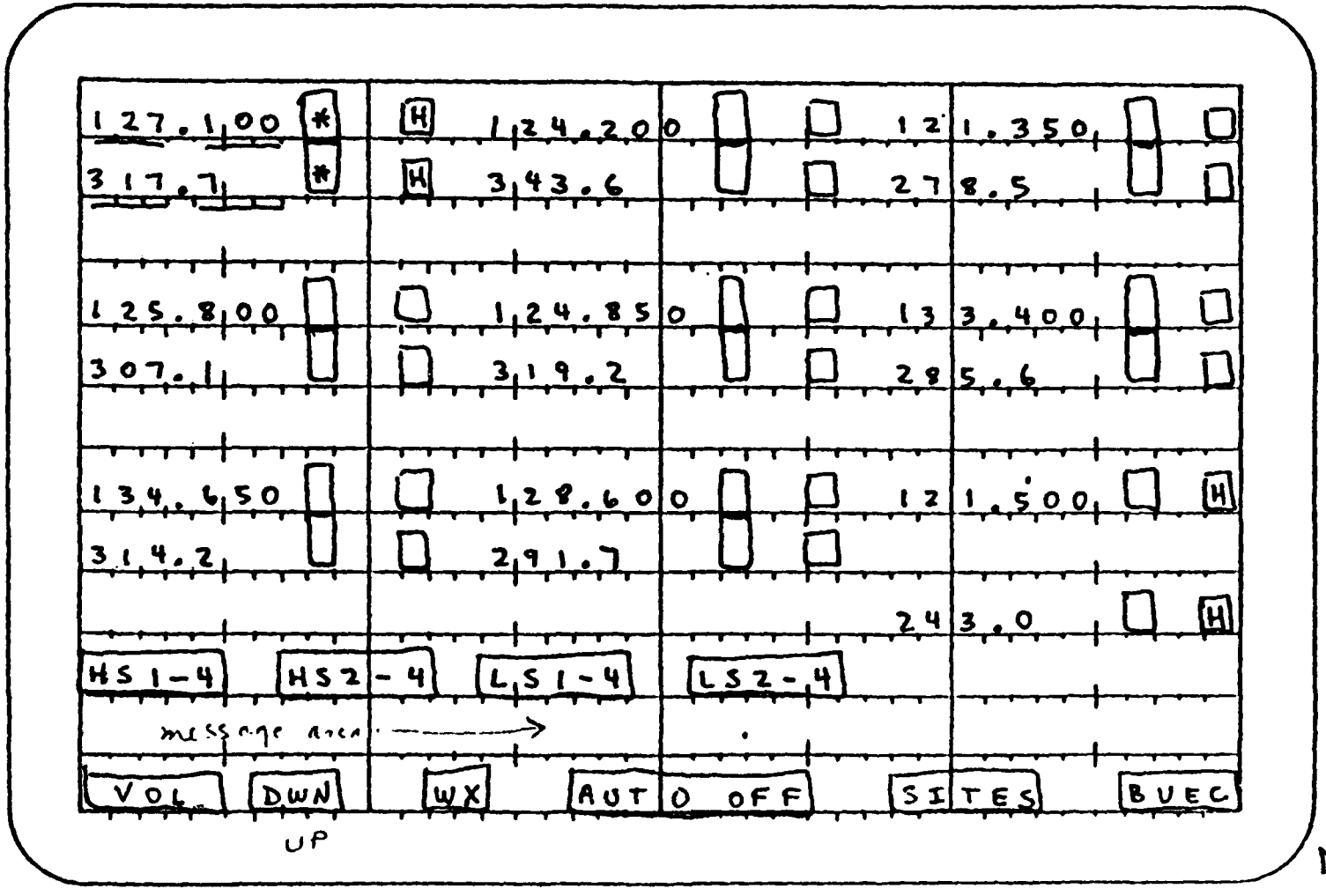
3. Incoming DA calls will flash (reverse video name will flash) until answered by a touch. Connected calls appear in reverse video with any of the appropriate designators of H=hold, O=override, C=conference, V=voice call.
4. An outgoing DA call is initiated by touching its normal video name (name goes to reverse video). The name will flash until the call is answered at the other end (display will then go to solid reverse video).
5. An active DA call is terminated by another touch to its name in reverse video.
6. Touching 'FUNC' will display the special functions (Drawing 2b).
   -XFER to transfer the current call
   -CONF
   Touch and it stays in reverse video until touched again. Any call initiated while this condition is on will be connected to the conference. When touched again, 'CONF' returns to normal video and all conference connections are released. The keypad is 'hot' and the 'IA' key need not be used.
   Display as many conferees as possible in the message area with scrolling to the right.
   -MON refers to monitoring another position. Touch MON and it goes to reverse video; enter a position code via the keypad. Display the position name temporarily in the message area. Terminate MON when it is touched again.
   -POS RELF
   Start position relief recording when this area is touched (goes to reverse video and a message appears in the message area and will not go away until this function is turned off). End the recording by touching this function name again.
   -Brightness and Chime are adjusted using 'LEVEL DWN' or 'LEVEL UP'.
   -'G/G-HS' and 'OVR-LS' toggle between HS and LS for ground communications.
7. Override calls coming in will display the OVERRIDE message below the IA keypad in reverse video. If more than one override call comes in, flash 'OVERRIDE'.
8. IA calls.
   Only incoming and CA queue calls will appear in the CA queue area and can be answered in any order. An outgoing IA call appears above the keypad unless it is placed on hold, then it moves to the lowest position in the queue.

VSCS DISPLAY ALTERNATIVE:



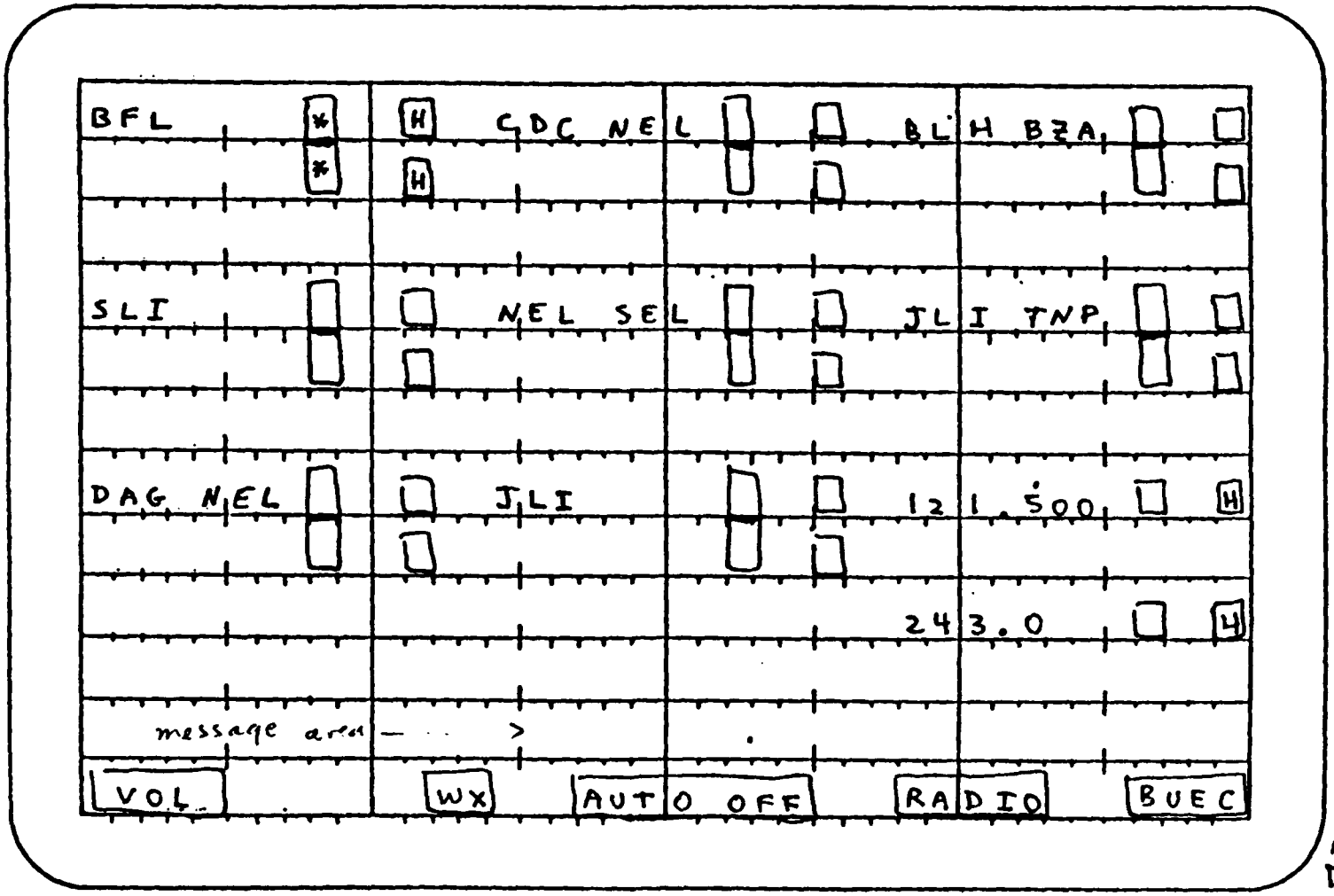
Alternative 1
Drawing 1a

VSCS DISPLAY ALTERNATIVE:



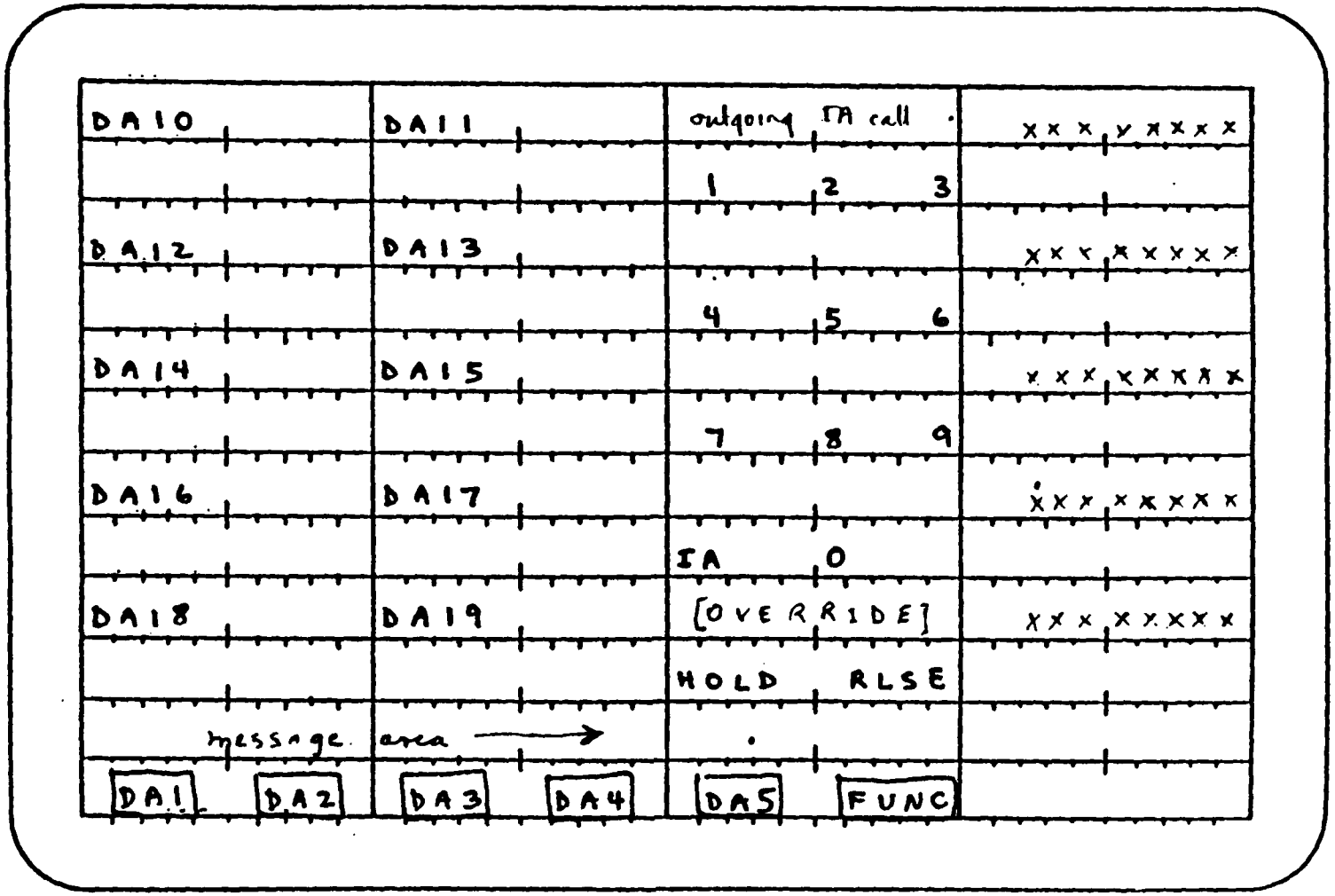
Alternative 1
Drawing 1b

VSCS DISPLAY ALTERNATIVE:



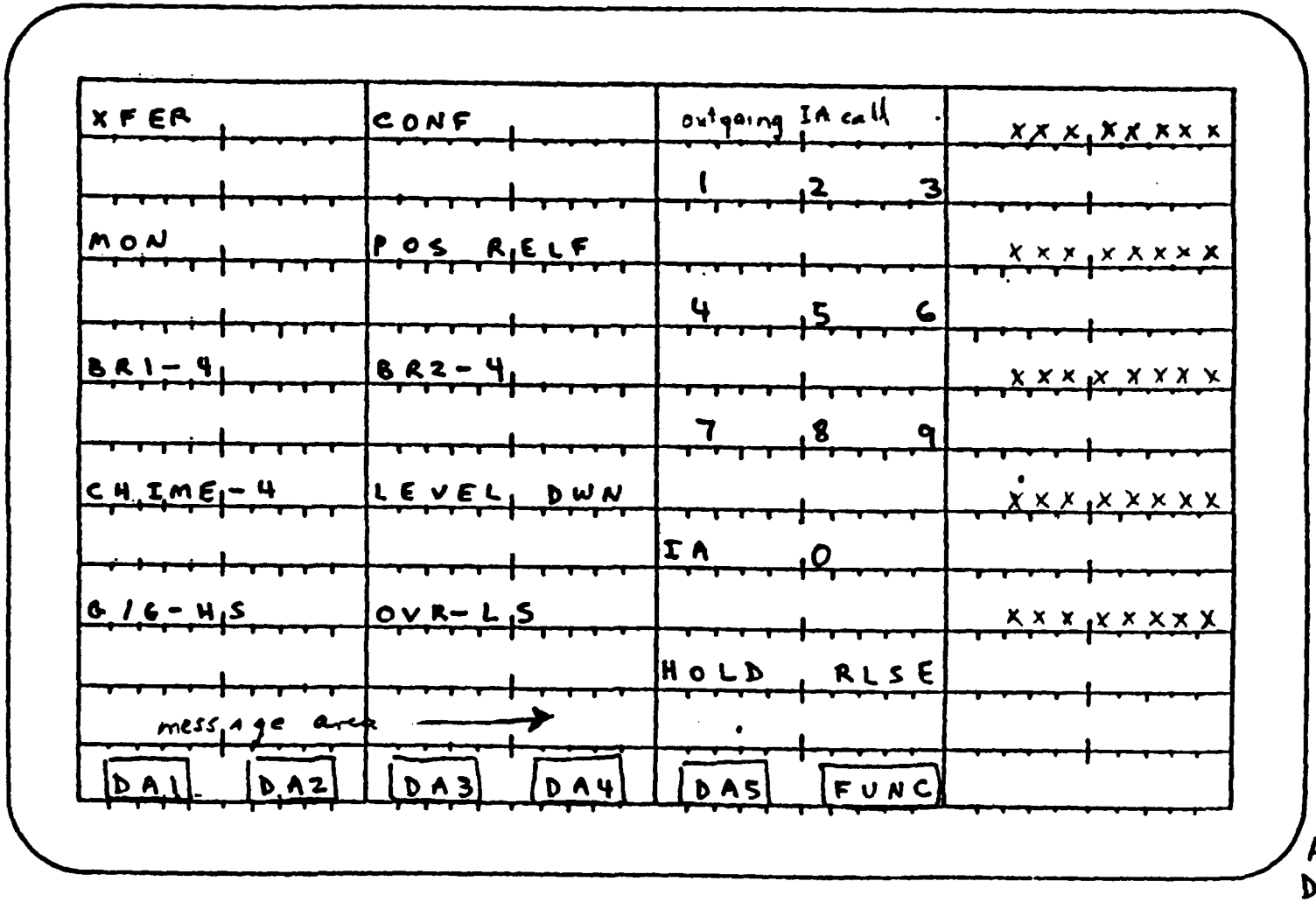
Alternative 1
Drawing 1c

VSCS DISPLAY ALTERNATIVE:



Alternative 1
Drawing 2a

VSCS DISPLAY ALTERNATIVE:



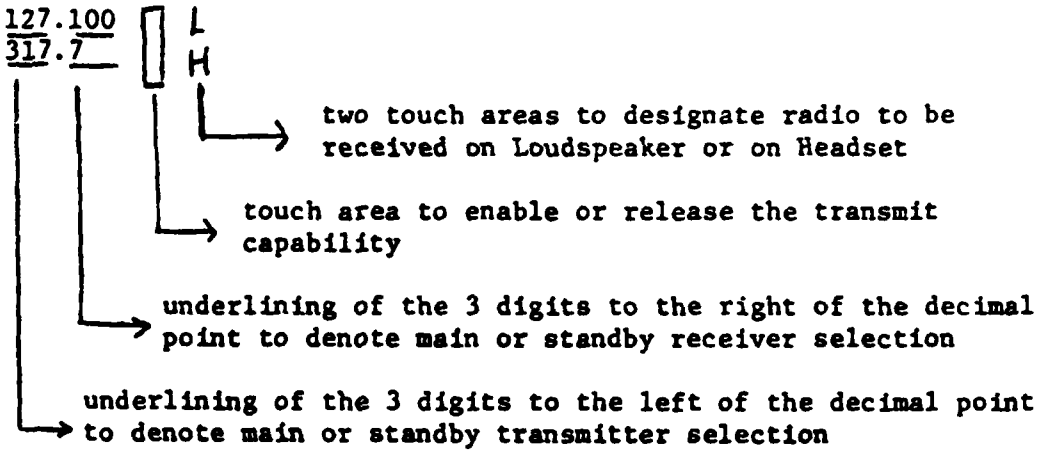
Alternative 1
Drawing 2b

VSCS DISPLAY ALTERNATIVES
ALTERNATIVE 1 [redacted]

AIR-GROUND PANEL

Displayed on this panel are eight (8) frequency pairs plus emergency frequencies that are available to the controller position. This allows for the display of 18 frequencies. If, however, a frequency is unpaired, then only one frequency will appear instead of the two frequencies.

Each frequency pair has the following format:



The functions and status indications for this display panel are

1. MAIN or STANDBY transmitter or receiver.
   In order to be able to select the MAIN or the STANDBY transmitter or receiver for the frequency pair, the transmission or receive capability must first be enabled. At that point, the currently defined selection is displayed as MAIN (solid underline) or STANDBY (dashed underline). To alternate to the non-selected option, merely touch the respective area to the left or to the right of the decimal points.

2. Enable transmission.
   When transmission is not selected the indicator box outline should be shown (black interior) and there should be no underlining of the frequency to the left of the decimal point. The transmit capability can be enabled by touching this box. The box will be colored a solid yellow and the transmit main/standby indication will appear as described in (1.) above. When there is a voice being transmitted over the frequency (via a PTT at this position or PTT at another position), blink the yellow box. When the voice stops (end of PTT activity), redisplay the solid yellow box if transmit is selected at this position or display the empty box of tx is not enabled at the position.

If two positions are trying to use the same frequency (both PTT active), and the other position has lockout over this position, then display the box as solid red until one position ends its PTT.

this position	another position	box	color	flash
tx not select	tx not select	empty	black	no
tx not select	tx but no PTT	empty	black	no
tx not select	tx with PTT	solid	yellow	yes
tx but no PTT	tx but no PTT	solid	yellow	no
tx but no PTT	tx with PTT	solid	yellow	yes
tx with PTT	tx but no PTT	solid	yellow	yes
tx with PTT	tx & PTT lockout	solid	red	no

3. Enable receiving of voice.
When receiving of a voice over a given frequency pair has not been enabled, no underline as described in (1) above will appear. Otherwise, the main/standby underline will be displayed when either the headset or the loudspeaker is activiated, i.e. when the receive capability is enabled, the 'L' or 'H' should be displayed in reverse video. A voice being received at the position should be indicated by flashing the reverse video 'L' or 'H'. When a voice is received on a frequency that does not have its receive enabled, flash the 'L' or 'H' in normal video. For the emergency frequencies (121.5 or 243.0), either the 'L' or the 'H' must be active (no underlining) and displayed in reverse video. The emergency frequencies receive capability cannot be turned off.

4. BUEC.
To enable the use of the BUEC transceiver (tx and rx), touch 'BUEC' (and it will be displayed in reverse video) and then touch the appropriate frequency pair. Do not indicate tx or rx with any underlining. Color the transmit status box yellow but do not flash it when there is a voice being transmitted (PTT action). Also, display the 'L' or 'H' in reverse video (whichever was last selected). There will be no flashing of this indicator either when a voice is received. If BUEC is touched and no frequency is selected within 5 seconds, turn off the BUEC reverse video indicator and do not accept a frequency designator. The BUEC indicator should remain in reverse video if any frequency pair has been placed on BUEC. The main or the standby tx or rx can be activated again (and automatically turn BUEC off for the frequency pair) by touching the respective tx or rx touch area to recall the previous definition.

5. EMERGENCY FREQUENCY.
An indication must be given whenever an emergency frequency is in use. When a voice is being received, place the frequency number in reverse video and flash the selected 'L' and 'H'. To transmit on one of the emergency frequencies touch the desired frequency (it goes to reverse video) and use the PTT feature within 10 seconds. The emergency frequency transmit capability is automatically turned off if there is no PTT activity for a period

of 10 seconds. The transmit status box should flash yellow if this position is using the transmit capability or should flash red if another position is transmitting on one of the frequencies.

6. Tx/Rx Site Selection.
Touch the box to display the abbreviated site locations for selectable transmitters and receivers. If a given site has been selected for use(one or more must be selected), display the site in reverse video. While these are being displayed, 'SITE' should be in reverse video. Select/deselect sites by touching the location and it will be displayed in reverse video/normal video. Touch 'SITE' again or if there have been no touches for 10 seconds, return to the original frequency display.

7. Weather dissemination.
To transmit a prerecorded weather message, touch 'WX' (and it goes to reverse video) and then touch the desired frequency pair. Flash the 'WX' indicator for 20 seconds to simulate the message being transmitted. Weather information can be transmitted over various frequencies simultaneously. When there are no more weather messages being sent, return 'WX' to normal video. The respective transmit capability for the frequency must have been previously enabled for this to work; if not, display the message 'CANNOT TRANSMIT WEATHER'. If a weather message is transmitted, also activate the appropriate transmit indicator.

8. Volume Control.
There is a provision to adjust the volume for the two headset jacks, the two speakers, and the chime (bell). The OFF condition is indicated by a zero (0) volume level. To change the volume, touch the desired headset, speaker, or chime indicator and either (1) enter the level number into the IA keypad or (2) successively touch the name to step through the available volume step levels. The levels will range from zero (0) to nine (9).

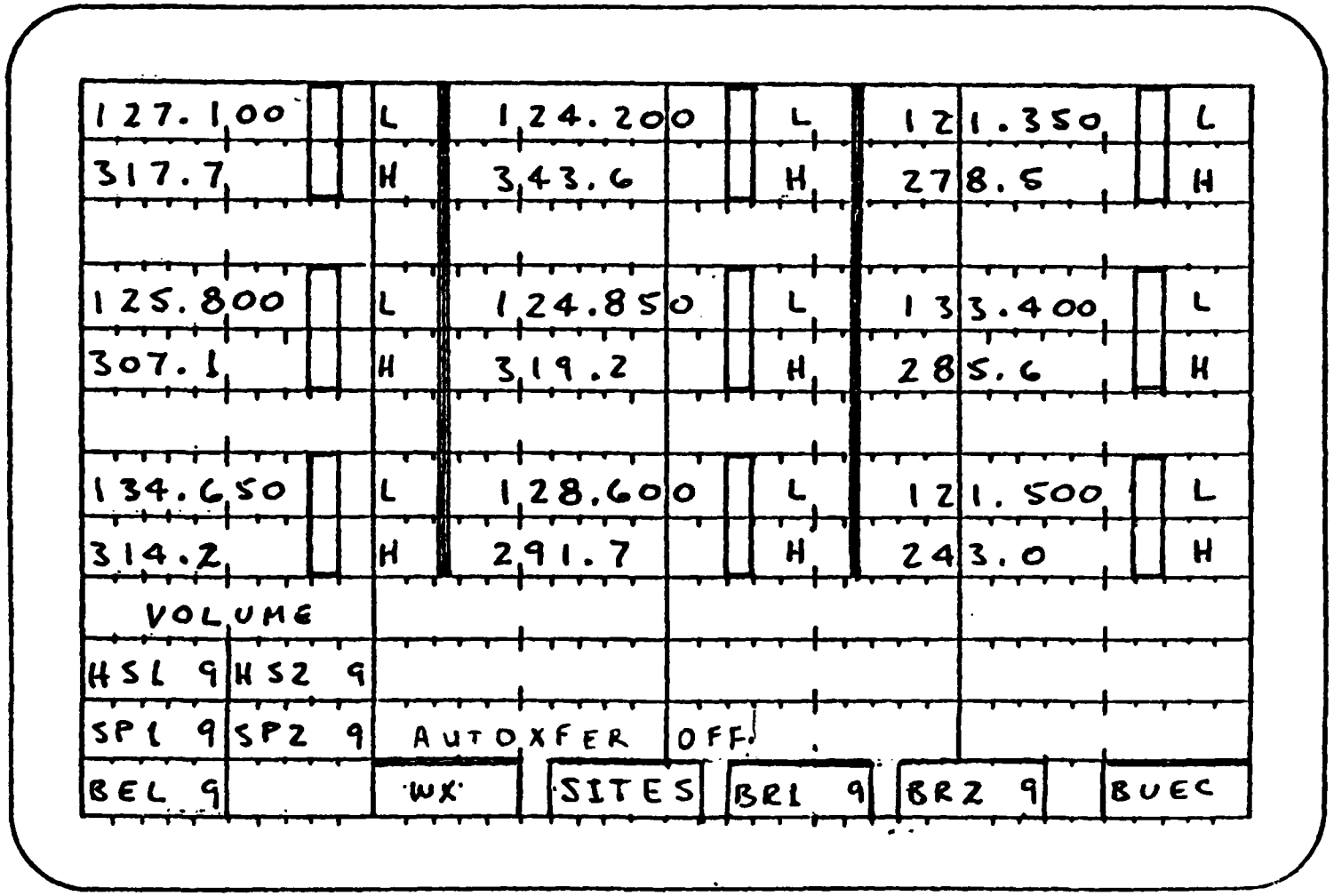
9. Brightness Adjustment.
The brightness for either display panel can be modified here in the same manner as adjusting volume. The adjustment levels are 0 thru 9 with zero being the lowest brightness level but not off.

10. Auto Transfer of Radio Voice.
This indication when ON means to temporarily transfer a radio voice to the loudspeaker whenever there is current ground-to-gound activity in the headset.

11. Special Functions.
See "IA DIALING - KEY CODE INDEX", function codes 30 to 47. These functions are activated without first touching the 'IA' key. Merely enter the desired code or code-sequence to activate the function.

12. A voice call is a DA call that must be terminated at both ends to end the connection, if the position answers the call. If a voice call is initiated (DA14) assume it is terminated at both ends at the same time.

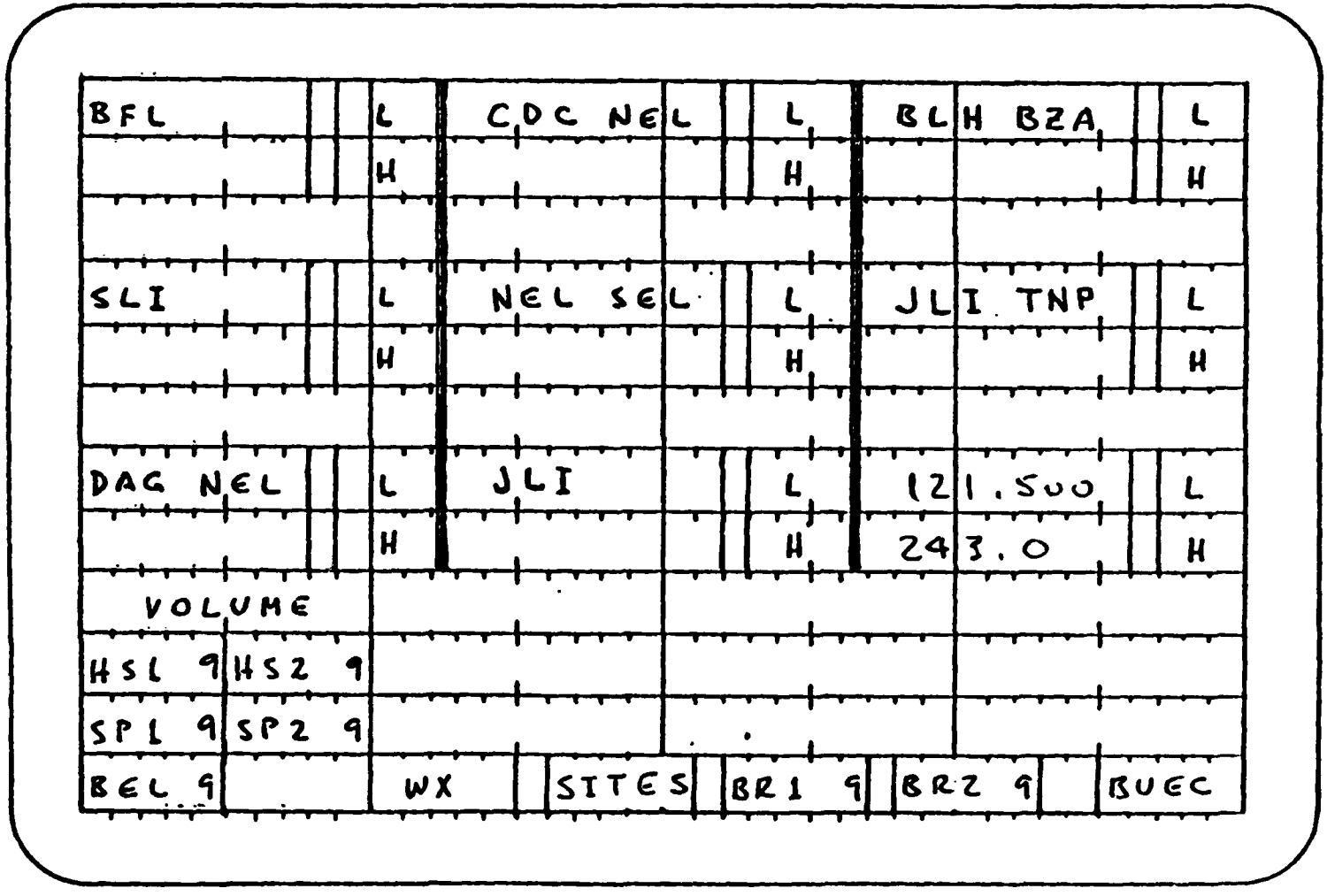
VSCS DISPLAY ALTERNATIVE: TWO TOUCH PANELS



Drawing 1
A/6

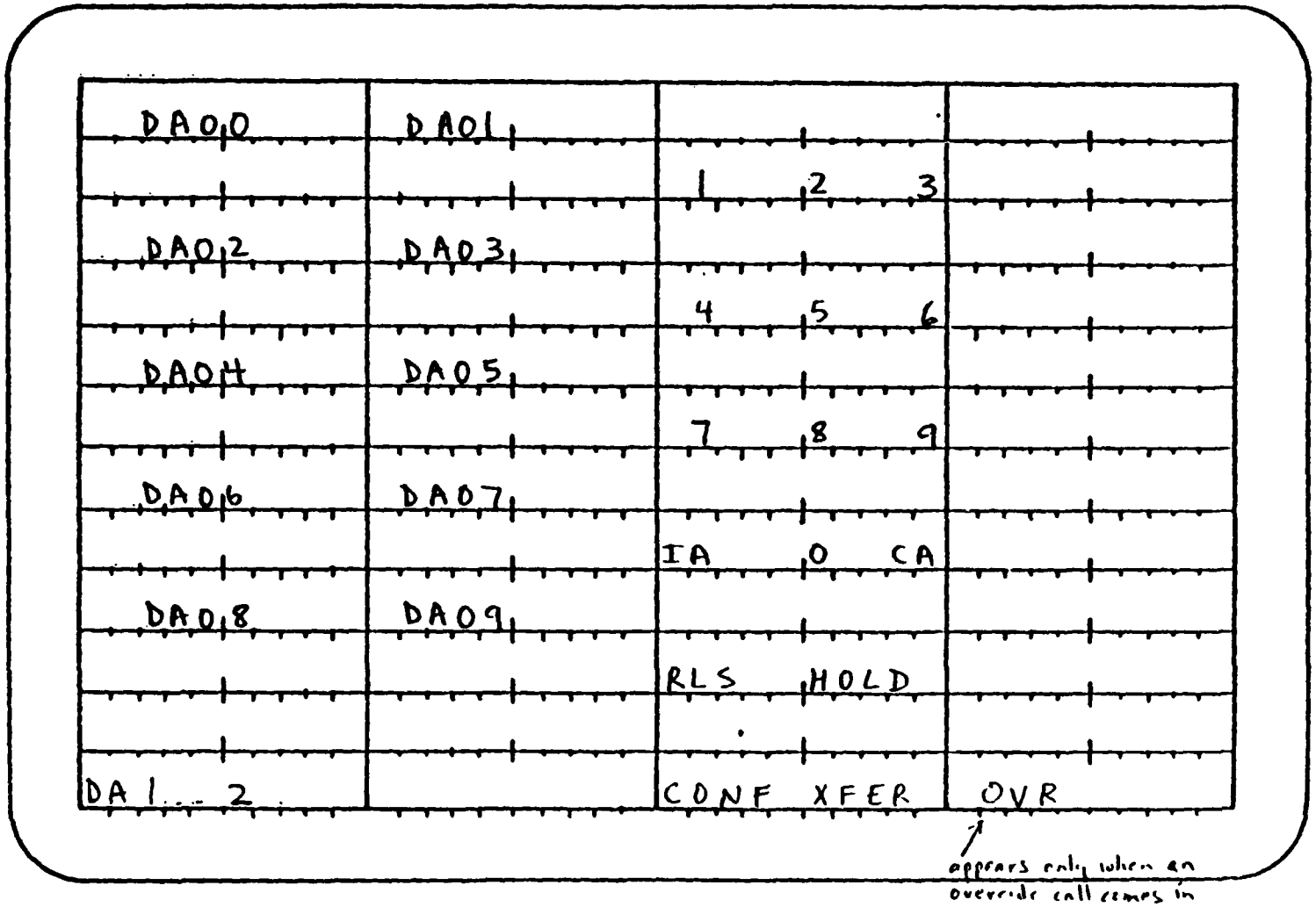
V0025
Y0005

VSCS DISPLAY ALTERNATIVE: TWO TOUCH PANELS



Drawing 2
A/G

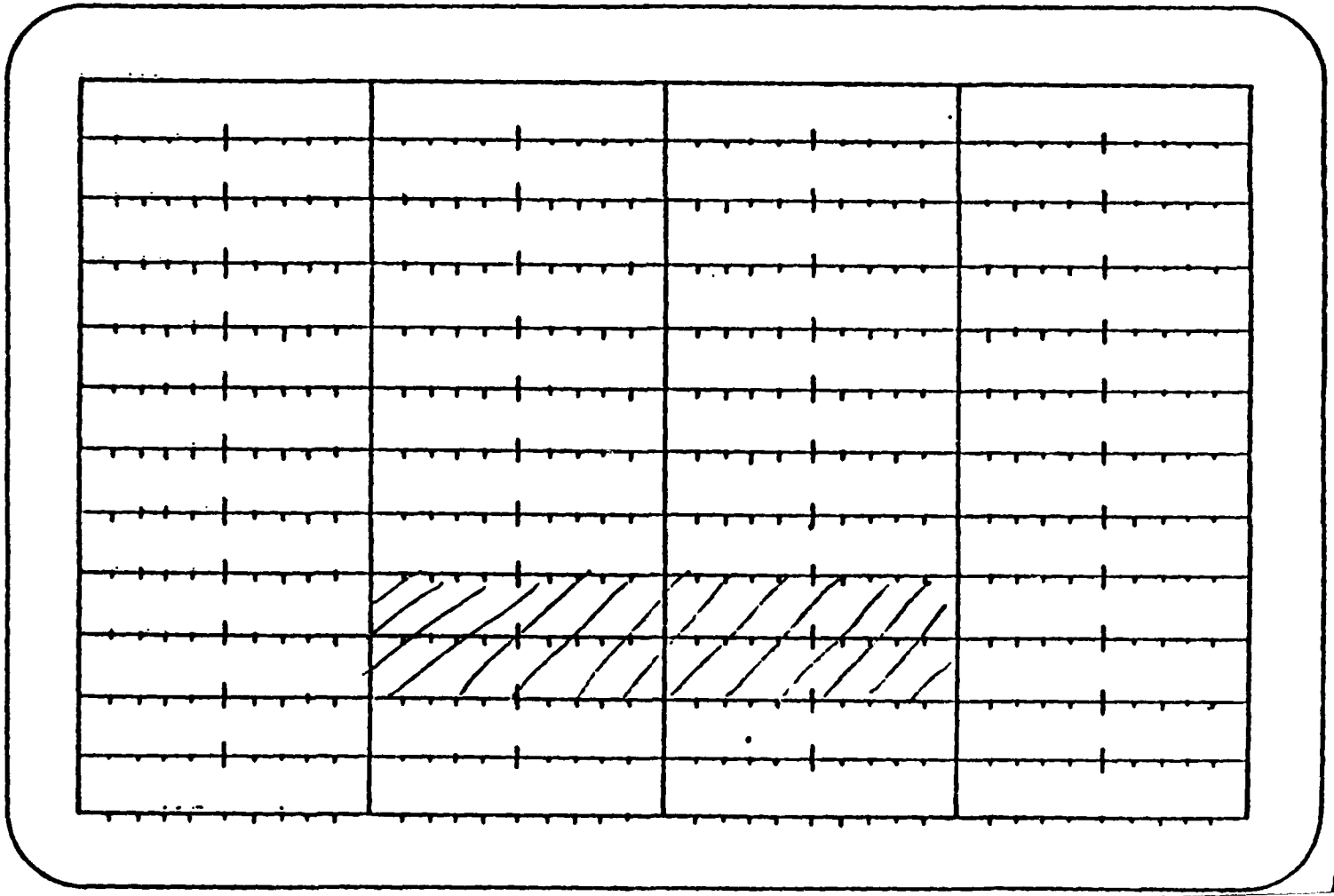
VSCS DISPLAY ALTERNATIVE: TWO TOUCH PANELS



Drawing 3
direct access

VSCS DISPLAY ALTERNATIVE:

A/G Touch Panel



Drawing 4

APPENDIX C

DISPLAY ALTERNATIVE 2 FORMATS

GENERAL COMMENTS

1. When "IA" is touched, change it from normal video to reverse video to indicate keypad entry required. When the entry is complete (or terminated), return the "IA" to normal video.

2. The chime level can go to zero (off).

3. Follow the guidelines below for the use of emergency frequencies (121.500 and 243.0).
   a. Use a default of receiver on, headset selected. These frequencies can alternate between headset and loudspeaker, but the receive function cannot be turned off.
   b. There are no MAIN/STANDBY indications and the frequency numbers are not valid touch areas.
   c. The headset or loudspeaker indicator for the desired frequency will flutter whenever voice is being received, just as with any other frequency.
   d. Transmitting/receiving
      - emergency frequencies are located at the bottom buttons on each side
      - receive is always enabled and the "R" indicator should always be displayed with the frequency
      - use the sequence RCVR -- HSET/LS -- frequency to alternate between headset and loudspeaker. This sequence must be accomplished within 5 seconds or the sequence is cleared. Either "H" or "L" must be displayed at all times (without the MAIN/STANDBY indication).
      - receiving a voice will cause the appropriate button to flutter and the R flutter.
      - select tx by touching the corresponding emergency frequency pushbutton. There is no need to use the XMTR pushbutton first, but that button can be used without harm.
      - when tx is selected, display a "T" for the frequency and light the button.
      - PTT will cause the button and the "T" to flutter.
      - touch a lighted emergency frequency button to force the tx function off. A 10 second delay with no voice on tx or rx will turn the tx function off.
      - On the G/G screen, the presence of voice for tx or rx will display the emergency frequency and the "R" or "TR" in reverse video. The frequency and the "T" or "R" will flutter. (When the emergency frequency is in use, the "R" will always appear.

4. Follow the instructions below for weather dissemination.
   a. Touch WX. It will be displayed in reverse video and will flutter in reverse video for 20 seconds to simulate the weather message being transmitted. All frequencies with tx enabled will flutter their indicator area also.
   b. If PTT or rx is activated during this process, either at this position or at another position which also has a frequency selected for tx, turn off all weather transmissions.

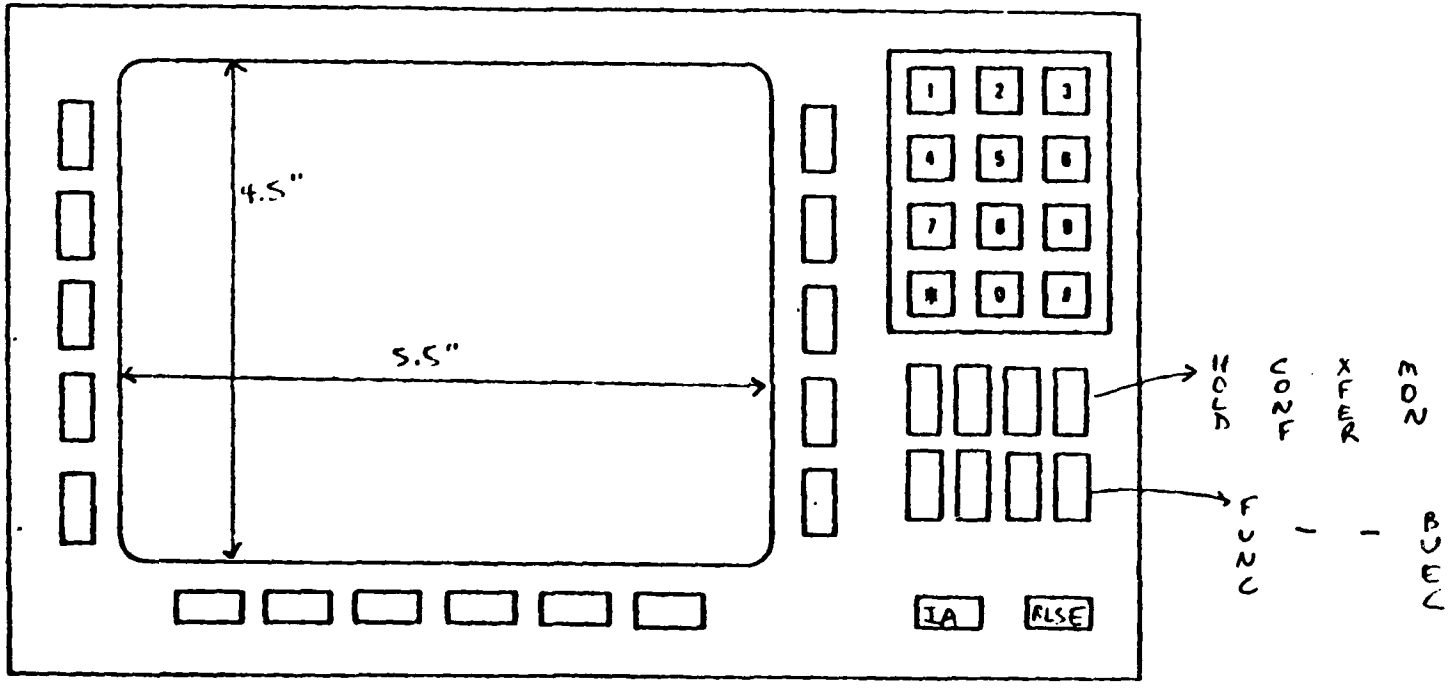
5. Releasing an active call means
   a. another party terminates the currently active call (except voice calls or incoming override).
   b. a new call is initiated via DA or IA.
   c. RLSE is touched.
   d. Unless processing a conference call, there can only be one active call at a time.

6. Do not display a site for emergency frequencies.

7. When tx is selected, automatically enable rx. If rx is deselected, automatically deselect tx.

VSCS DISPLAY ALTERNATIVE: CRT AND PUSHBUTTONS

ALTERNATIVE 2



A/G AND D/A DISPLAYS

IA: FUNCTIONS

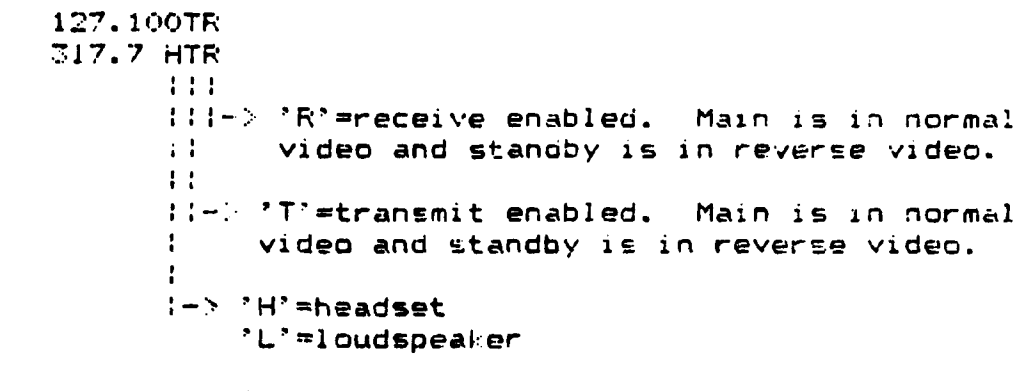
ESTIMATED DISPLAY SIZE OF 12.5"W x 7"H x 9.5"
THE CRT HAS 16 LINES OF 32 CHARACTERS

V0025
Y0008

Alternative 2.

The CRT should have white letters and any pushbutton that lights up should have the entire button lit. Assume white pushbuttons too.

RADIO SCREEN



In the center of the screen at the top is the common answer queue that contains the list of ground-ground IA incoming calls and any outgoing IA call on hold. Any call in this queue area can be answered at any time.

The frequency pairs are on the left and right with the emergency frequencies at the bottom.

Bottom Line.
'DA' button will flash if there are any unanswered DA or IA calls(incoming or outgoing). It will be in reverse video if there are any other active calls.
Selecting transmit ('XMTR' or 'RCVR') will cause a T or R to appear to the side of the frequency number in normal (main selected) or in reverse video (standby selected).
When PTT occurs, all frequency pairs selected for tx will have their 'T' and pushbutton flutter (PTT lockout at any frequency will result in a steady lit pushbutton but 'T' fluttering.
When a voice is received, the 'R' and the pushbutton will display syllabic fluttering.

DIRECT ACCESS SCREEN

Calls are initiated, answered, etc. via an adjacent pushbutton. Any call on hold, in conference, or classified as override or as a voice call, will have this reference printed above the DA name (HOLD, CONF, OVR, VOICE). CA queue calls will display H, C, O, or V after the call identity.
For CA queue calls, use the CA button on the bottom row of the screen to make the calls available for answering, as previously described.
Active radio will have the frequency and its 'T' or 'R' flutter with the presence of voice. The main/standby indicators are

valid for display on this screen. Both 'T' and 'R' may appear for each frequency.

The bottom line displays and paging options to display are listed below.

current page	bottom line					
DA1	CA	DA2	DA3	DA4	DA5	RADIO
DA2	CA	DA1	DA3	DA4	DA5	RADIO
DA3	CA	DA1	DA2	DA4	DA5	RADIO
DA4	CA	DA1	DA2	DA3	DA5	RADIO
DA5	CA	DA1	DA2	DA3	DA4	RADIO

When going from the radio display or from the special functions display to the DA display, use the automatic page select feature as previously described.

Special Function Button

The CA button under the IA keypad is no longer used. A new button, for calling a special function display has been added at this location and the button is labelled 'FUNC'. When touched, the special function display (Drawing 3) will appear.

-POSN RELIEF
Position relief reordings will occur when this button is touched (name stays in reverse video until recording stops). A message will appear in the message area while recording is in effect. Stop recording by calling this display again (if it is not already up) and touch this button again (name goes back to normal video).

-G/G HSET/SPKR
Touching the button toggles this definition between headset and loudspeaker.

-OVR HSET/SPKR
Touching the button toggles this definition between headset and loudspeaker.

-SCREEN LVL 4
Check the DOWN/UP button on the bottom row for the desired direction and then successively touch this pushbutton until the desired level is reached.

-BUTTON LVL 4
same as above

-LVL 4 HSET1
same as above

-LVL 4 HSET2
same as above

-LVL 4 SPKR1
same as above

-LVL 4 SPKR2
same as above

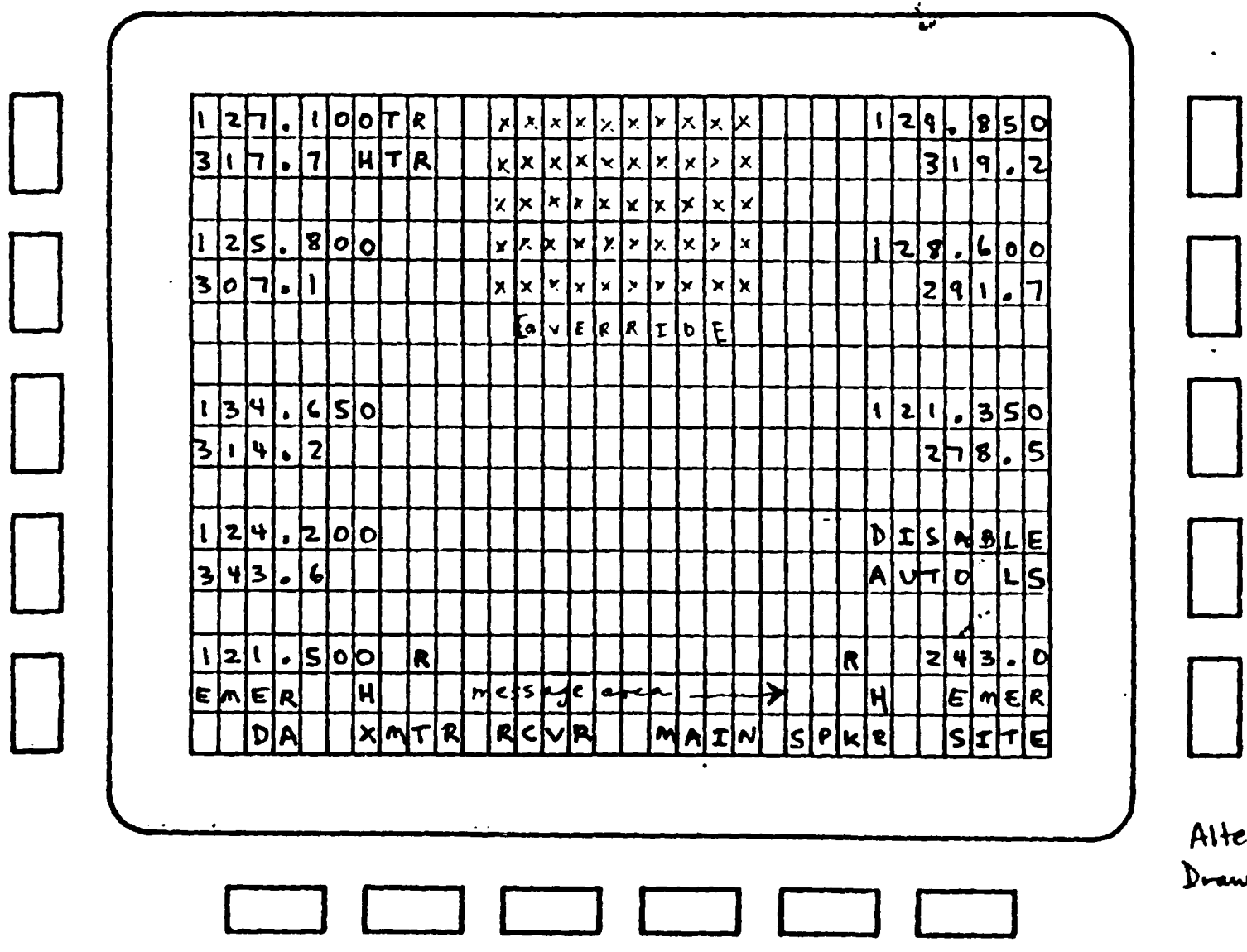
-LVL 4 CHIME
same as above

-WX
Touch this button and 'WX' goes to reverse video, the button flutters, and all tx's flutter for 20 seconds; then all are automatically turned off. PTT interrupts turns off all WX transmissions.

Return to RADIO or DA activities by touching the appropriate

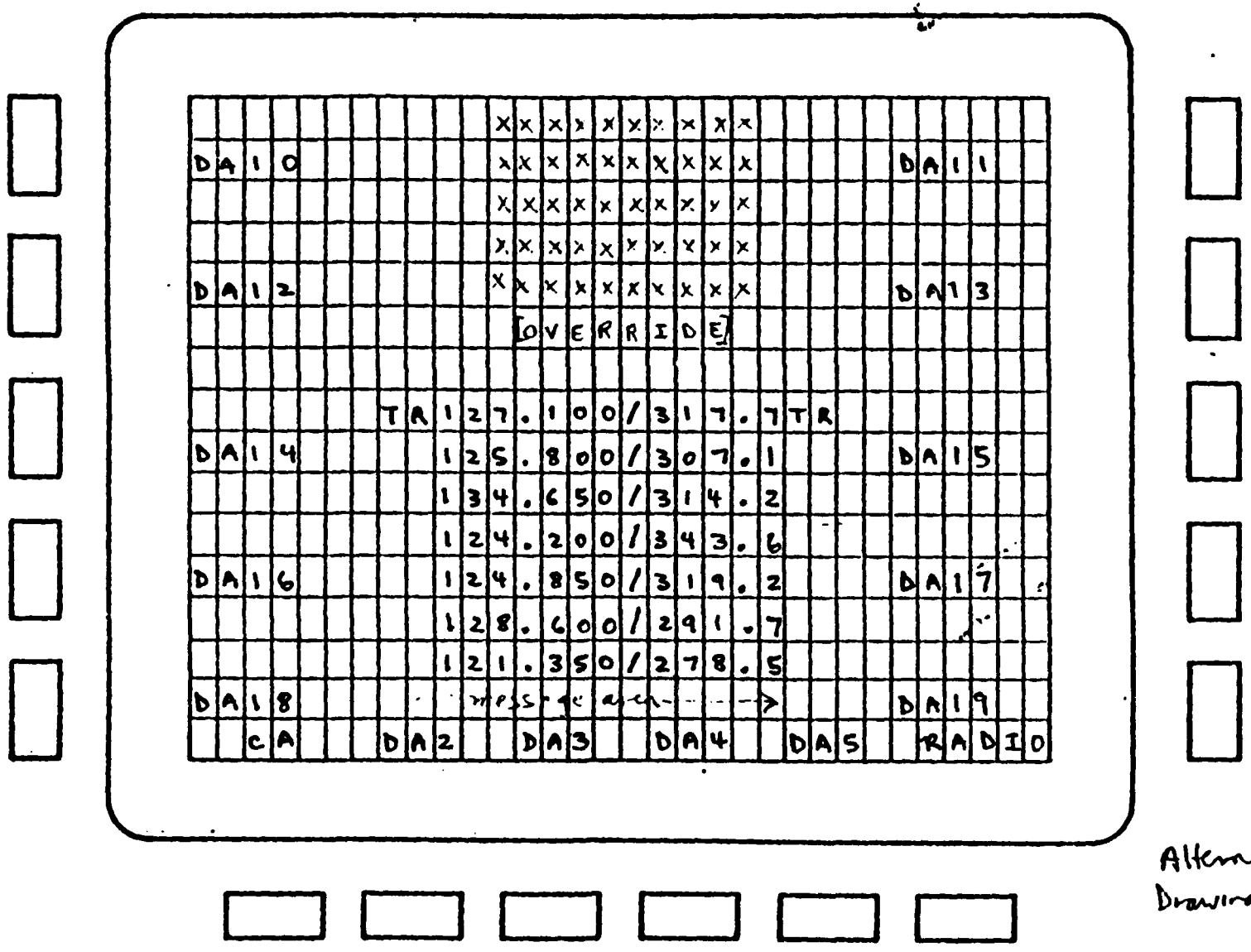
pushbutton on the bottom row. The automatic DA page determination applies when leaving this display too. If any active calls are in effect or any call comes in, display these conditions via the 'DA' on the bottom row.

VSCS DISPLAY ALTERNATIVE: CRT WITH PUSHBUTTON



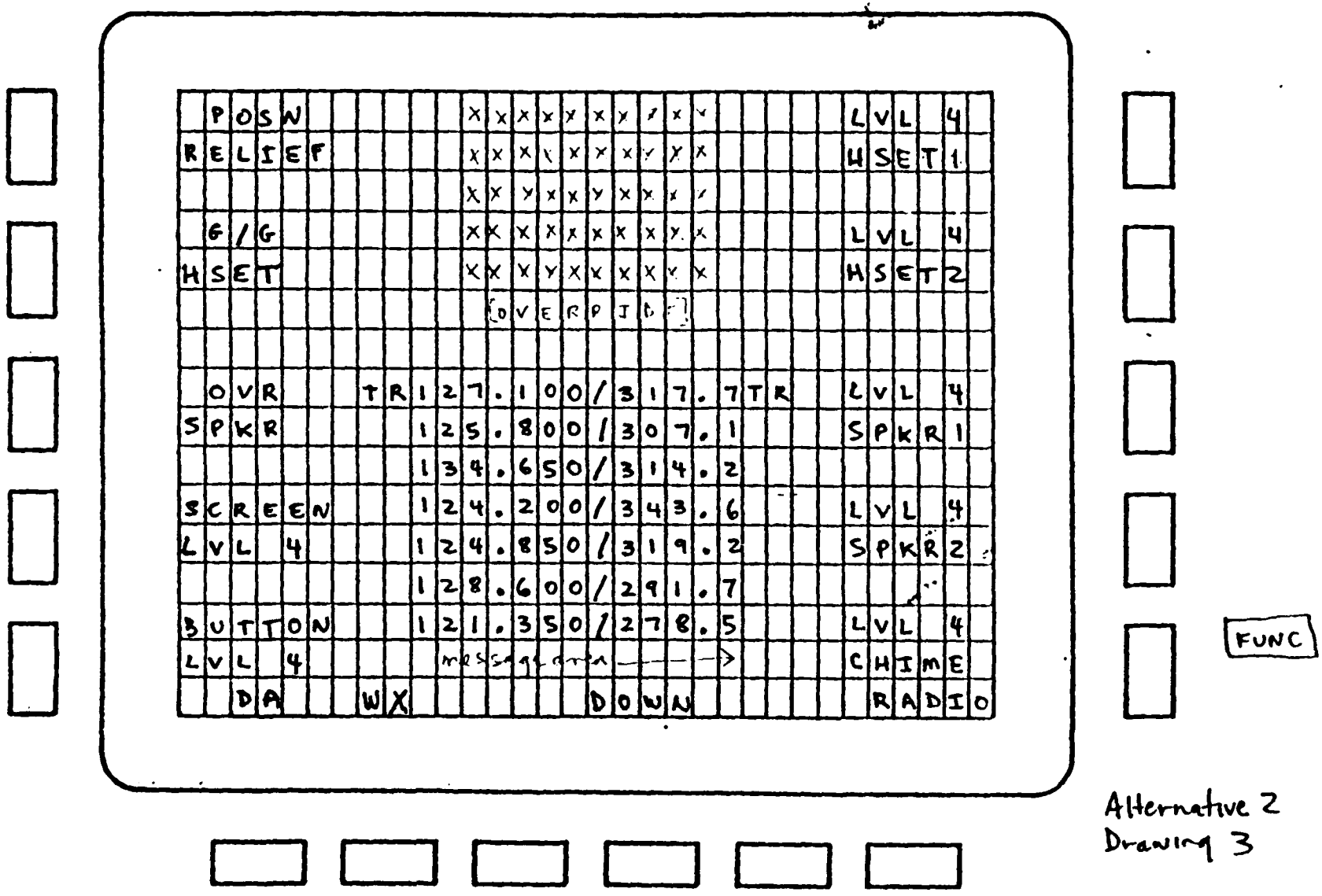
Alternative 2
Drawing 1

VSCS DISPLAY ALTERNATIVE: CRT WITH PUSHBUTTON



Alternative 2
Drawing 2

VSCS DISPLAY ALTERNATIVE: CRT WITH PUSHBUTTON



Alternative 2
Drawing 3

VSCS DISPLAY ALTERNATIVES
ALTERNATIVE 2 [redacted]

RADIO SCREEN

Displayed below is a frequency pair and its legend

```
127.100TM
317.7 HRM
 !     !!!
 !     !!-> M=main
 !     !!   S=standby
 !     !!   These appear after 'T' or 'R' to denote the
 !     !!   selection of main/standby sites
 !     !!
 !     !--> T=transmit
 !     !    R=receive
 !     !
 !     ---> H=headset
 !          L=loudspeaker
 !          Whenever 'R' (receive) is enabled, the voice
 !          must be routed to the headset or loudspeaker
 !
 ---> frequency pair of 127.100 and 317.7
```

In the center of the screen, at the top, is the common answer queue that contains the list of all active ground-ground calls, or at least the first five (5). Any active indirect access or direct access call is placed here.

Listed on the left and the right are the frequency pairs. Notice that on the right, the two emergency frequencies are listed separately. To use an emergency frequency, touch its respective pushbutton (the pushbutton will light and the frequency will be displayed in reverse video). Whenever a pause of more than 5 seconds occurs without using the push-to-talk (PTT) feature, the emergency frequency transmit capability is turned off. When PTT is engaged, a 'T' will appear next to the frequency and the pushbutton will FLUTTER. (There is no 'M' or 'S' displayed for the emergency frequencies.)

The bottom button on the right side is for the special radio function to automatically route radio voice to the loudspeaker when there is a g/g connection to the headset. Displayed will be

```
DISABLE      or
AUTO LS                AUTO LS
  !                      !
  !                      -> transfer radio to loudspeaker
  !                         when there is already g/g voice
  !                         in the headset
  !
  --> ignore automatic transfer and place radio receive
      voice in headset or loudspeaker as designated
```

The bottom line contains

DA	XMTR	RCVR	MAIN	SPKR	SITE
(a)	(c)	(c)	(b)	(b)	(d)

(a) Touch the pushbutton corresponding to this indicator to return to the g/g displays for direct access. Display 'DA1' will appear if there are no currently active direct access lines. Otherwise, the first page ('DA1' through 'DA5') will be displayed if it has a connected call (current voice connection or call on hold or call to be answered). A trunk line in use by other positions will be lowest on the priority.

'DA' will be displayed in reverse video if there is an active g/g call. All active calls will appear in the CA queue, even if it is a DA call. The DA pushbutton will FLASH if there is a call waiting to be answered.

(b) Touching these pushbuttons will alternate the specification options between MAIN-STBY and between SPKR-HSET.

MAIN/STBY is used to denote which transmitter or receiver to use when transmit or receive is enabled.

SPKR/HSET is used to denote the routing of the receive voice to the position's loudspeaker or to the headset for the frequency pair. See Drawing 2.

(c) Touching 'XMTR' and/or 'RCVR' pushbuttons and then indicating a frequency pair will enable or remove the respective transmit and/or receive capability. When either of these are touched, the 'SITE' button will display the current definition of which of the frequency pairs to modify, i.e. UHF only, VHF only, or both ('UHF', 'VHF', 'BOTH'). Change to another default option by successive touches to this button before touching the frequency pair pushbutton. Underline to the left of the decimal point for transmit selected on the frequency and underline to the right of the decimal point for receive selected.

When 'XMTR', transmit, is enabled, the 'T' will appear after the VHF frequency and the corresponding MAIN/STBY designator (see (b) above) will follow it as 'M' or 'S'. Whenever a PTT occurs, all frequency pairs selected for transmit will have this 'T' in reverse video and the corresponding pushbutton will FLUTTER. PTT lockout will result in the pushbutton being steadily lit.

When 'RCVR', receive, is enabled, the 'R' will appear on the UHF frequency line along with (1) MAIN/STBY designator of 'M' or 'S' and (2) HSET/SPKR designator of 'H' or 'L'. When receiver voice arrives, the 'R' will go to reverse video and the pushbutton will show a syllabic flutter.

When 'XMTR' or 'RCVR' are touched, the pushbutton will light and

will remain lit for 10 seconds or until a frequency pair is selected (via pushbutton) or by pushing the 'XMTR' or 'RCVR' button again. When transmit or receive is selected, the CRT display will change to show this selection along with the main/standby indicator and the headset/loudspeaker ('RCVR' only). If a transmit or receive capability is removed,the designators for transmit/receive or main/standby or HS/LS ('T'/'R' or 'M'/'S' or 'H'/'L') will be blanked out.

(d) Touch the 'SITE' pushbutton to (see drawing 3),

1. light the pushbutton
2. change the two adjacent pushbutton functions on the bottom to 'DSBL' and 'ENAB'
3. display the site designators for the frequency pair over the UHF frequency (bottom one). Selected sites should appear in reverse video, otherwise display them in normal video.

The emergency frequency areas will not change, i.e. they will not display any site locations.

To enable or disable a site from its transmission and receive function, touch the 'DSBL' or 'ENAB' and then touch the corresponding site pushbutton (left or right of CRT screen). The 'DSBL' or 'ENAB' pushbutton will remain lit (within a reasonable time) until the release or selection is made. If additional sites are available, display an '*' (asterisk) following the site designator and display the next site if the site pushbutton is touched without 'DSBL' or 'ENAB' lit.

Return to the display of all frequencies by touching the 'SITE' pushbutton again. The pushbutton light will go out.

Finally, there is a message area above the bottom line which will be used to display when position relief recording is in progress or weather data transmission has been selected or other messages.

DIRECT ACCESS SCREEN

Displayed on the left and right are the direct access calls available from this page, the common answer queue (top middle five lines), message areas, an active radio status, and the bottom row to call another display.

(a) DA calls.
Initiate a call by touching the corresponding pushbutton. The DA name will go to reverse video and the pushbutton will FLASH until the call is answered or FLUTTER when the connection is made. A DA call on hold will have its pushbutton WINK.

To terminate a call, either touch the corresponding pushbutton again,

initiate another call, or touch the 'RLSE' button located below the 1A keypad. The DA name will return to normal video and the pushbutton light will be off.

An incoming call will be displayed in FLASHing reverse video with a corresponding pushbutton FLASH. When answered, via touch, the name will be a steady reverse video but the button will FLUTTER. An incoming override call will bypass the FLASH state and will cause the 'OVERRIDE' indicator to appear in the center in reverse video. Any subsequent override calls arriving (2 or more override calls active at a time) will result in the reverse video 'OVERRIDE' indicator to FLASH. Normally, the 'OVERRIDE' indicator is not visible, but is displayed on either screen when a call comes in.

A call on hold will have 'HOLD' written above the DA name or an 'H' will be appended to the name in the CA queue. Similar activity is performed with conference ('CONF' or 'C') calls, override ('OVR' or 'O') calls, or voice ('VOICE' or 'V') calls.

(b) CA / Active Queue.
Any active g/g call will appear in the CA queue (even DA call names). When the queue is full, 1A calls will get a busy signal or be forwarded. Any DA calls will continue to be accepted but will not be displayed in the CA queue.

To access a call in the CA queue, touch the 'CA' button and the calls will be displayed next to the buttons on the left with the CA light on.

When the CA queue is displayed, the pushbuttons on the left will reflect the status of those lines. When displayed on the left, the CA calls will be in reverse video, but when displayed in the center,. they will be in normal video. The status of the DA calls that this overwrites is displayed in the center (i.e. DA and CA exchange places).

To return to the original display, touch 'CA' again to exchange these areas again. The 'CA' light will go out.

(c) Use of Emergency Frequency
Normally the emergency frequency line ' 121.5 /243.0 ' will be blank. When a voice is received on one of the emergency frequencies, the frequency will appear in reverse video (this occurs on the radio screen too) but will FLASH here since there is no associated pushbutton. When someone transmits over one of the emergency frequencies, the frequency will appear in reverse video (without FLASH) with an accompanying flashing 'T'.

(d) Active Radio
All active radio frequencies available to a position are displayed in the frequency pair groupings, allowing the monitoring of 7 frequency pairs (14 frequencies) plus the emergency frequencies described above. Any frequency pair that has been designated for transmit or receive will be displayed in reverse video. If transmit is enabled, a 'T' will appear next to

the frequency.

When voice is received, the frequency pair will FLASH. When transmit occurs, the 'T' will FLASH. If PTT lockout occurs, change the FLASHing 'T' to a reverse video 'T'.

The botton line contains

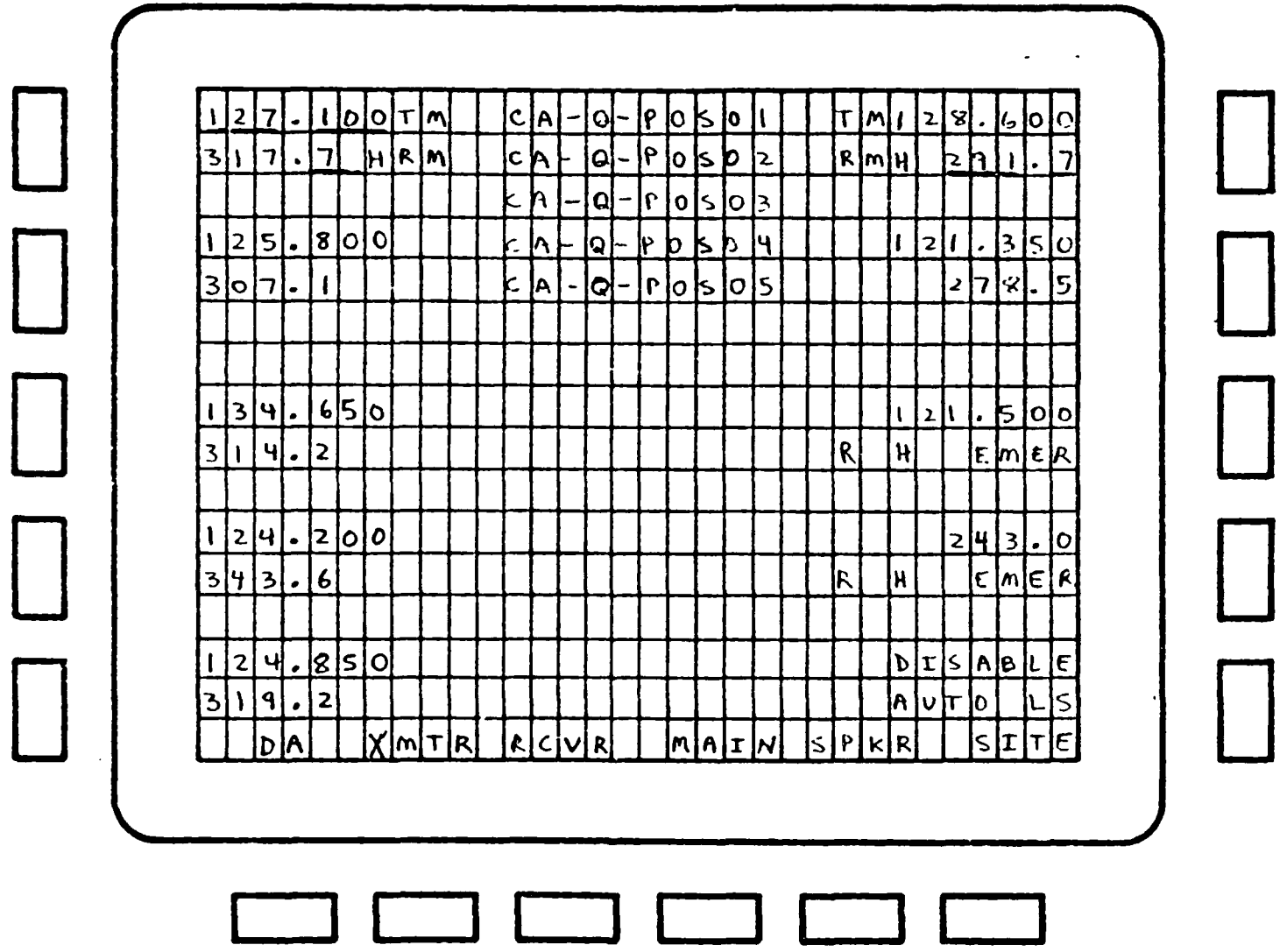
CA	DA2	DA3	DA4	DA5	RADIO
(b)	(e)	(e)	(e)	(e)	!
					v
					touch pushbutton to go to the radio screen format

(e) Other DA activity
These indicators will appear in normal video when ther is no activity on the pages. The normal video will flash if there is a call on the page that is on hold or is an override call. The corresponding button will WINK if there is a call on hold there.

It is possible for a call on a page to have an active trunk but it is not connected to this position. This will be denoted by a STEADY reverse video indicator. If that page is called, the corresponding call name will appear in reverse video and the pushbutton will be STEADY on.

A pushbutton will only FLASH or FLUTTER if there is a connection on that page.

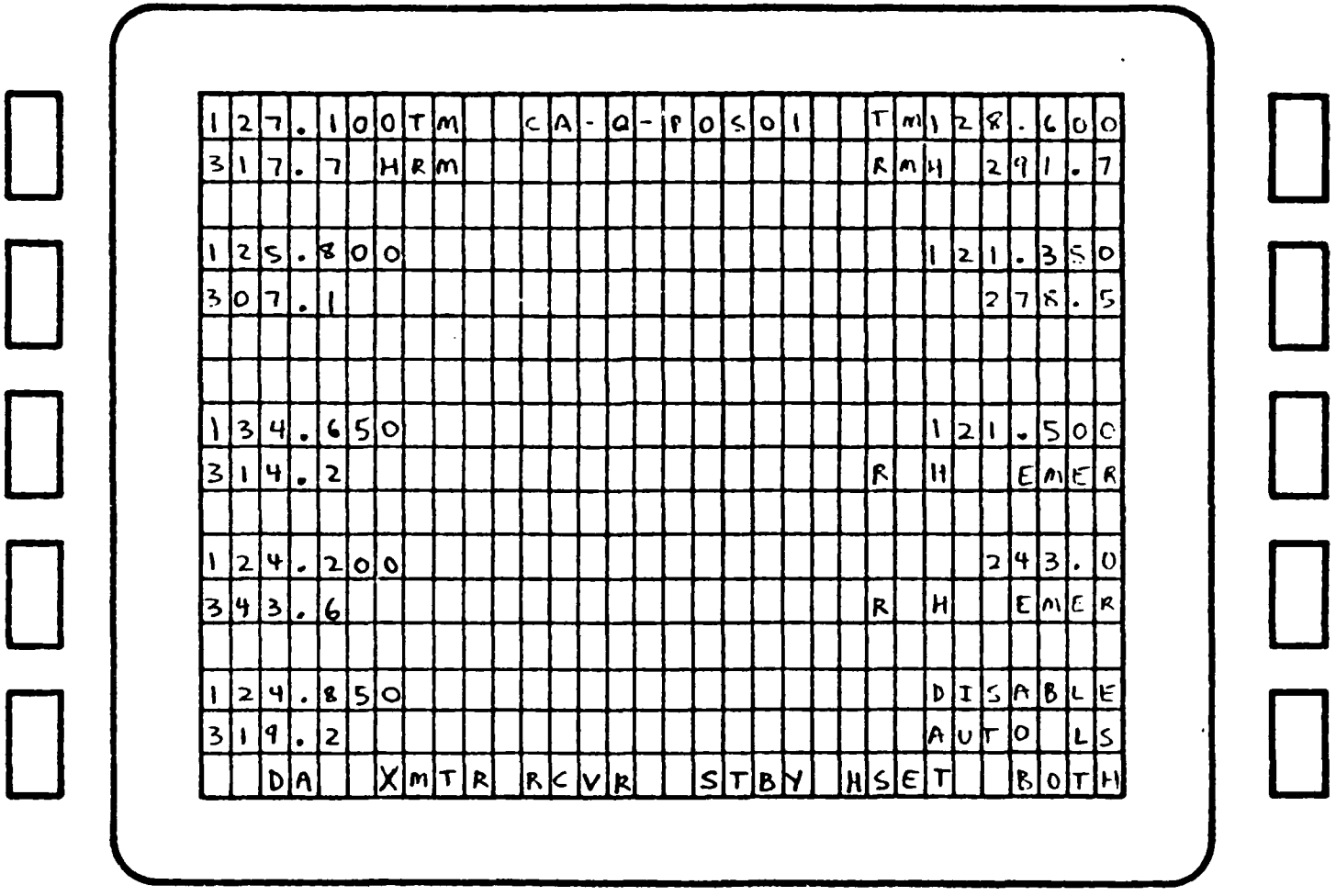
VSCS DISPLAY ALTERNATIVE: CRT WITH PUSHBUTTON

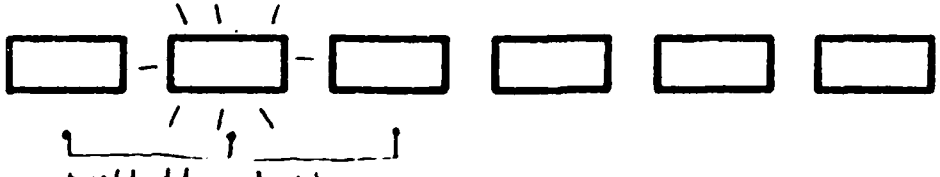


V0025
Y0003

Drawing 1

VSCS DISPLAY ALTERNATIVE: CRT WITH PUSHBUTTON



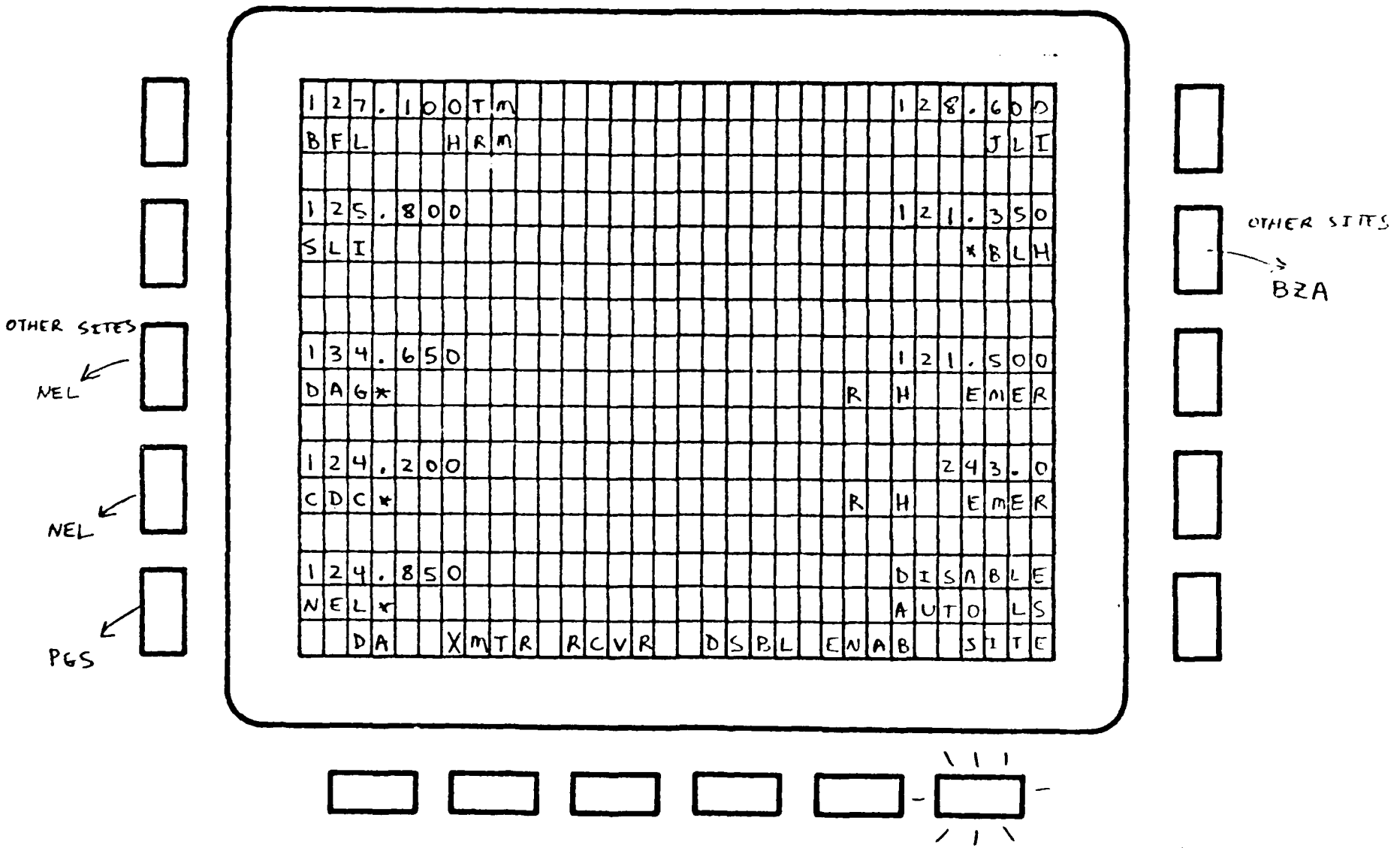


C-16

V0025
Y0003

Drawing 2
Radio

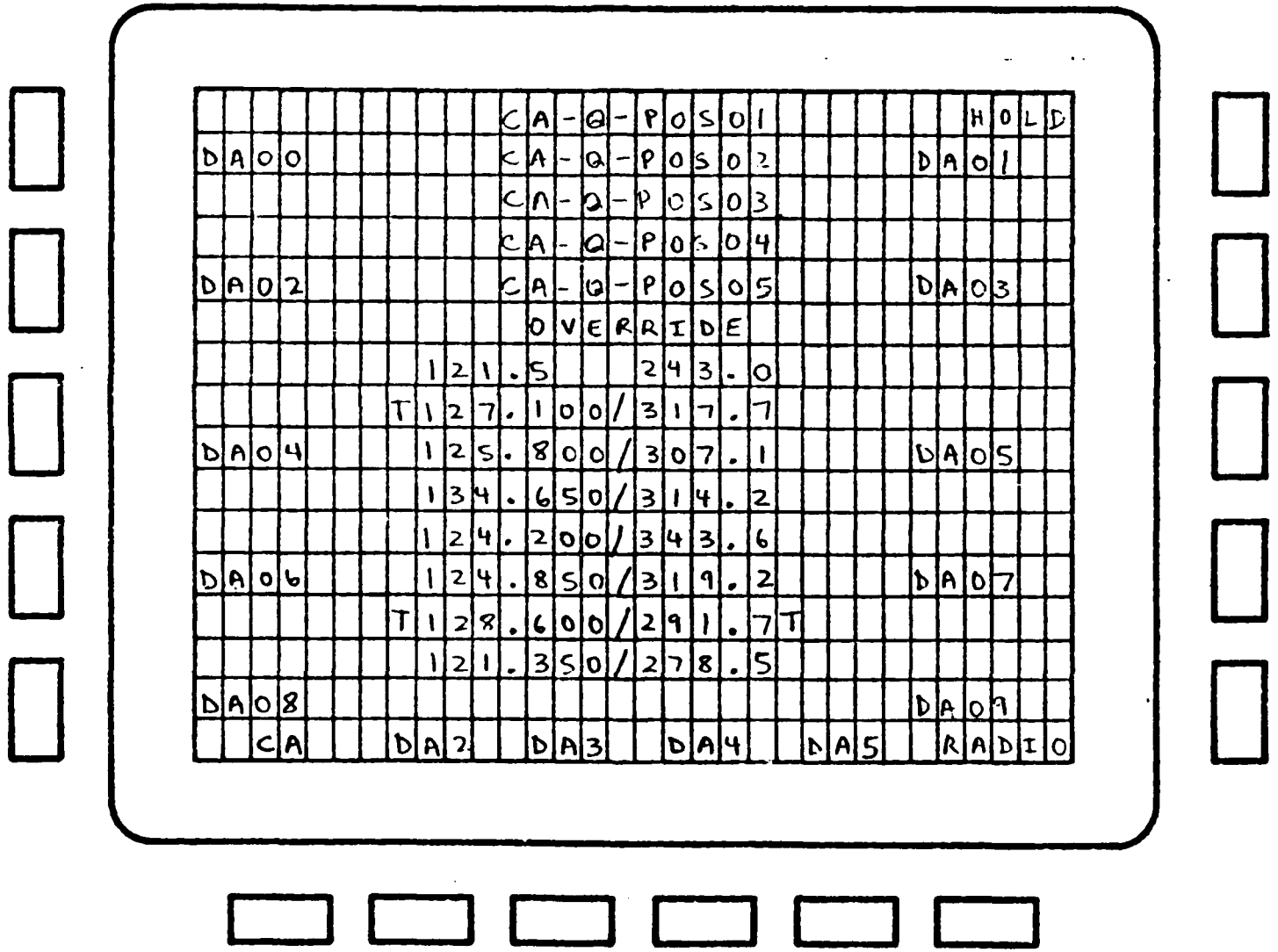
VSCS DISPLAY ALTERNATIVE: CRT WITH PUSHBUTTON



V0025
Y0003

Drawing 3
Raden

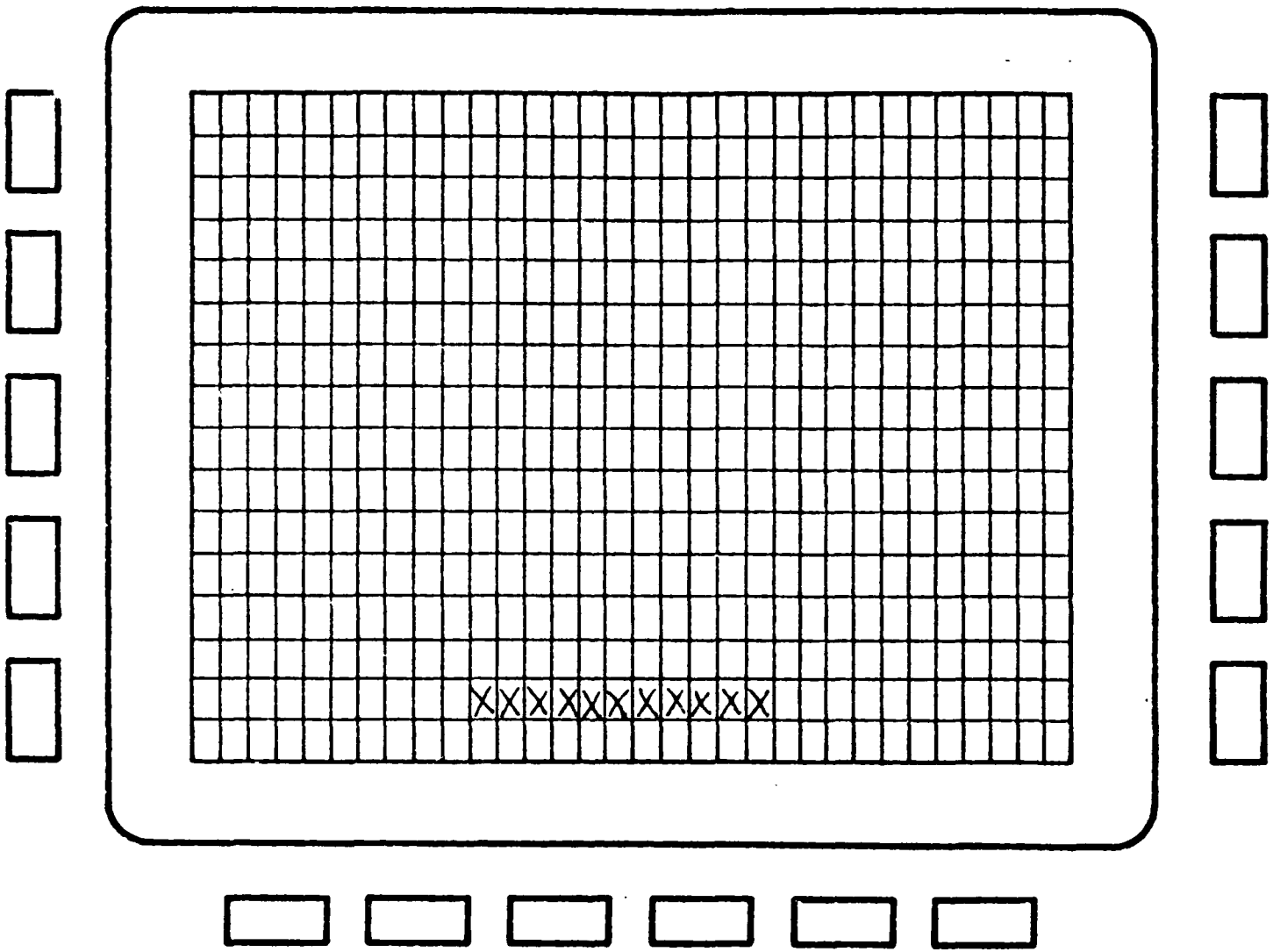
VSCS DISPLAY ALTERNATIVE: CRT WITH PUSHBUTTON



Drawing 4
Direct Access 1

V0025
Y0003

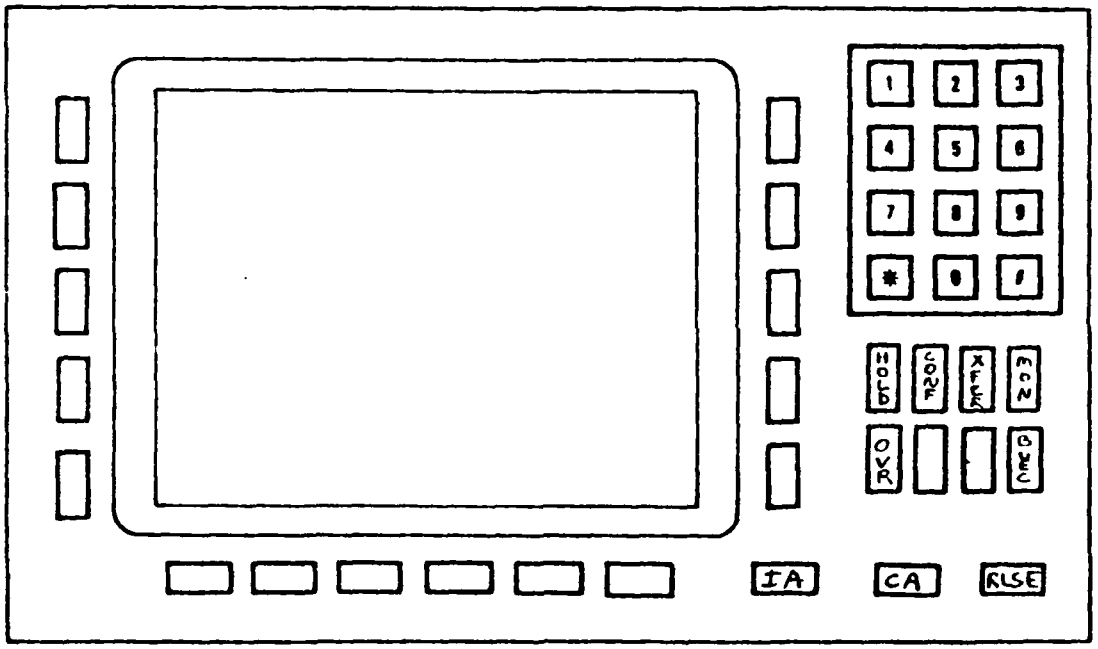
VSCS DISPLAY ALTERNATIVE: CRT WITH PUSHBUTTON



V0025
Y0003

Drawing 5
Message Area

VSCS DISPLAY ALTERNATIVE: CRT AND PUSHBUTTONS



A/G AND D/A DISPLAYS

IA: FUNCTIONS

IA: initiate IA call
CA: answer IA call in
RLSE: release (cancel) current call or function

BUTTON ASSIGNMENTS

HOLD: initiate the holding of the active call
CONF: ON: conference calling in progress
XFER: transfer
MON: initiate remote position monitoring
BUEC: activate BUEC
OVR: override status for incoming calls only

ESTIMATED DISPLAY SIZE OF 12.5"W x 7"H x 9.5"
THE CRT HAS 16 LINES OF 32 CHARACTERS

Drawing 6
IA buttons

V0025
Y0008

APPENDIX D

DISPLAY ALTERNATIVE 3 FORMATS

GENERAL COMMENTS

1. When "IA" is touched, change it from normal video to reverse video to indicate keypad entry required. When the entry is complete (or terminated), return the "IA" to normal video.

2. The chime level can go to zero (off).

3. Follow the guidelines below for the use of emergency frequencies (121.500 and 243.0).
   a. Use a default of receiver on, headset selected. These frequencies can alternate between headset and loudspeaker, but the receive function cannot be turned off.
   b. There are no MAIN/STANDBY indications and the frequency numbers are not valid touch areas.
   c. The headset or loudspeaker indicator for the desired frequency will flutter whenever voice is being received, just as with any other frequency.
   d. Enabling transmission
      - tx, when off, will be turned on by touching the tx bar for the desired emergency frequency.
      - tx selected is indicated by an "*" placed in the indicator bar in line with the frequency.
      - PTT with tx selected will flutter the tx indicator bar ("*" normal and reverse video).
      - no PTT or rx within 10 seconds will automatically turn off the tx capability (i.e. return the frequency to normal video and turn off the tx indicator bar).
      - when tx is selected, touching the "*" will turn tx off.

4. Follow the instructions below for weather dissemination.
   a. Touch WX. It will be displayed in reverse video and will flutter in reverse video for 20 seconds to simulate the weather message being transmitted. All frequencies with tx enabled will flutter their indicator area also.
   b. If PTT or rx is activated during this process, either at this position or at another position which also has a frequency selected for tx, turn off all weather transmissions.

5. Releasing an active call means
   a. another party terminates the currently active call (except voice calls or incoming override).
   b. a new call is initiated via DA or IA.
   c. RLSE is touched.
   d. Unless processing a conference call, there can only be one active call at a time.

6. Do not display a site for emergency frequencies.

7. When tx is selected, automatically enable rx. If rx is deselected, automatically deselect tx.

8. Make the STANDBY underline indicator more distinct from the MAIN indicator.

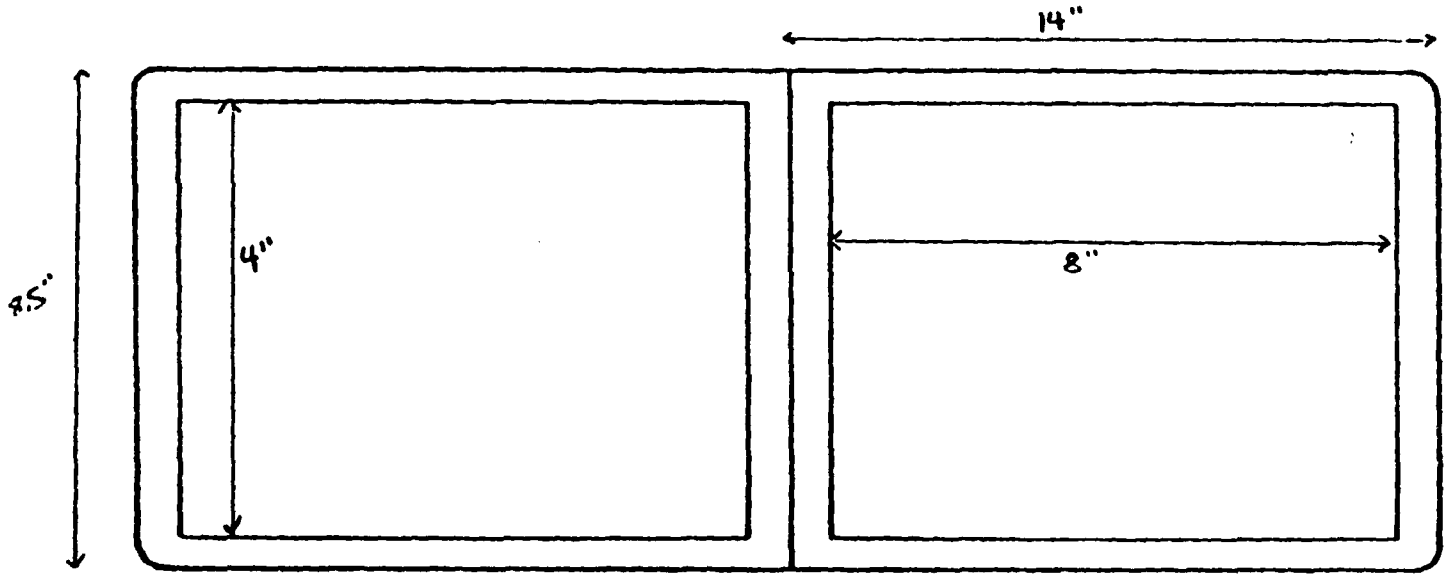
9. There should be an indication message when the position relief recording is in progress. This message may be temporarily interrupted when displaying other messages.

10. There should be no underlining when changing a BUEC selected tx/rx from headset to loudspeaker and vice versa.

11. Use "RLSE" on both displays instead of "RLS".

VSCS DISPLAY ALTERNATIVE: TWO TOUCH PANELS

ALTERNATIVE 3



ESTIMATED DISPLAY SIZE OF 26 "W x8.5"H x "D
EACH TOUCH PANEL HAS 16 LINES OF 64 CHARACTERS

Air-to-Ground Panel (Radio)

The Air-to-Ground Panel will now contain only the A/G functions with the exception of a G/G Panel-invoked Conference Status display.

The frequency-pair area will now be displayed in the following manner:

```
136.755  !*! - !H!
           !
347.5    !*! - !H!
```

Usage:

1. XMTR/RCVR selection

   Touching a transmitter indicator box will turn on the associated transmitter/receiver. If the selected frequency is on of a frequency pair, then both pairs are turned on. Selection will be indicated by an '*' (asterisk) within the transmitter indicator box. Transmission on the frequency/frequencies will be shown by flashing the transmitter indicator box (reverse/normal video). Reception on the frequency/frequencies will be shown by flashing the receiver indicator box(es).

   PTT with the transmitter indicator box already flashing will cause it to go steady, and a 'XMTR IN USE' message will appear in the message area (PTT will be locked out).

   Touching an already selected transmitter indicator box will cause the associated transmitter to be turned off, shown by a blank transmitter indicator box.

2. RCVR selection

   If a receiver has not been selected, then selection will be accomplished by touching the associated receiver indicator box. 'H' (Headset) or 'L' (Loudspeaker), whichever last selected, (or default, if no prior selection), will appear within the box.

   If a receiver has already been selected, then touching the receiver indicator box will cause it to toggle between 'H' and 'L'. If the receiver is one of a selected frequency pair, then both receiver indicator boxes will show the same selection.

   To turn a selected receiver OFF, the associated receiver box must be touched TWICE in rapid succession. The OFF condition will be shown by a blank receiver indicator box.

3. MAIN/STBY transmitter/receiver selection

   XMTR or RCVR selection as described in 1 and 2 above will also cause the last selected (or default) indication of MAIN/STBY to be shown for the tranmsitter/receiver. MAIN transmitter selection is indicated by a SOLID underline under the associate

frequency integer digits (e.g., 134.000); STBY transmitter selection by a DASHED underline (134.000). MAIN Receiver selection is indicated by a SOLID underline under the associated frequency "fraction" digits (e.g., 134.000); STBY receiver selection by a DASHED underline (134.000).

Touching a selected MAIN/STBY area will cause the indication to toggle between MAIN and STBY for the touched transmitter or receiver.

4. Emergency frequency selection

The emergency frequencies (121.500 and 243.0) are grouped in the lower right-hand corner of the A/G display. Selection of XMTR is the same as described above, with the exception that there will be no MAIN/STBY indication, and the receivers cannot be turned off.

5. Volume/brightness adjustment

Volume/brightness adjustment is enabled by touching the 'VOL' box in the lower left-hand corner of the A/G panel. The 'VOL' box will go to reverse video, and 'UP' will appear immediately adjacent to the 'VOL' box. Touching the 'UP' area will cause it to toggle between 'UP' and 'DWN. The message area and the line above the message area will become touch-enabled with the following display: (the 4's indicate default values)

4	4	4	4	4	4	4
HS1	HS2	SP1	SP2	CHM	BR1	BR2

Touching any of the areas will result in the level value to increment/decrement by 1, depending on the UP/DWN status.

All values will cycle in a circular manner between 1 and 9, except for CHM, which can go to 0 (Off).

Touching 'VOL' again, or 10 seconds after the last level selection, will cause 'VOL' to go to normal video, and all level and UP/DWN indicators to clear.

5. SITES selection

Touching the 'SITES' area will cause the site designators associated with each frequency/frequency pair to replace the frequency digits (VHF frequency digits for a frequency pair), and the word 'RADIO' to replace 'SITES'.

Site selection is indicated by the site designator appearing in reverse video. Selection/deselection of a site is accomplished by touching a site designator. An unselected site will be selected, and a selected site will be deselected, providing that there is at least one selected site for the frequency/frequency pair.

Ground-to-Ground Panel

The Ground-to-Ground panel now contains 25 direct-access selection areas. Other areas will function in the same manner as before with the following exceptions:

1. Direct Access calls

The 'ALT DA' area will be used to alternate between the two pages of direct-access selections. Each page will contain up to 25 DA selection points.

A direct-access call can be made by touching the appropriate box. The box will FLASH (reverse video/normal video) while the call is "ringing", and will appear in STEADY reverse video when the call is answered.

A D/A call can be terminated by (1) touching the 'lighted' D/A box; (2) touching the 'RLSE' box; (3) initiating another G/G call; or (4) answering another G/G call.

Special conditions for a D/A call are:

a. HOLD (H)
b. CONFERENCE (C)
c. OVERRIDE (O)
d. VOICE CALL (V)

The special conditions will be shown by 'H ', 'C ', 'O ', or 'V ' in reverse video immediately in front of the D/A box.

An incoming non-override D/A call will be indicated by flashing the appropriate D/A box. An answered D/A call (override or non-override) will be shown by a STEADY reverse video. (An incoming D/A override call will also cause the word 'OVERRIDE' appear in its designated area.

2. Indirect Access calls

The I/A keypad will be "hot". Any number sequence selected on the keypad will be displayed in the message area as the numbers are being selected. If the number is valid, it will FLASH while the call is "ringing", and go STEADY and remain displayed in the message area for 10 seconds or until the call is terminated.

I/A calls can be terminated by (1) touching the 'RLSE' area; (2) initiating another G/G call; or (3) answering another G/G call.

Any I/A call may be put on hold by touching the 'HOLD' area. The number suffixed by 'H' will be placed in the call answer area (queue).

-- MORE --

3. Conference calls

Conference calls are initiated by touching the 'CONF' area. The 'CONF' area will go to STEADY reverse video until touched again. The 'MON' area will re-write to 'STATUS'.

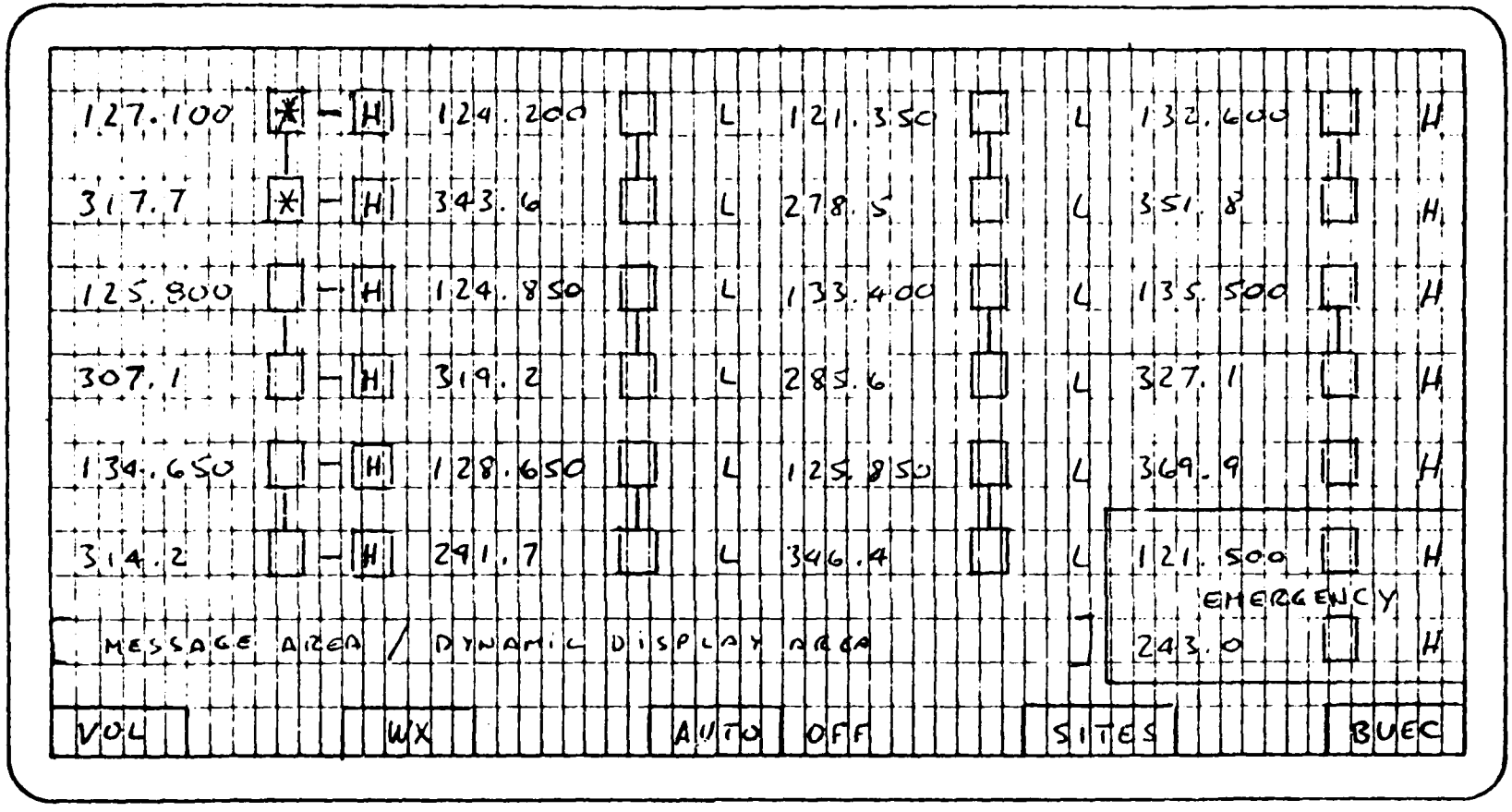
Any calls, direct access or indirect access, initiated while 'CONF' is selected will be assumed to be in the conference. D/A calls will be included by touching the appropriate D/A box. I/A calls will be included by dialing the I/A number.

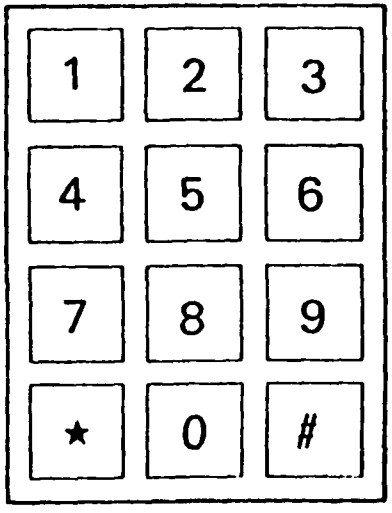
If the 'STATUS' area is touched, the A/G screen will re-write to the CONFERENCE STATUS display, and all calls, as they are completed, will be shown on the status display.

If the status display has not been selected, then the calls will be displayed on the bottom line of the G/G panel, up to and including the first five completed conference calls. A sixth completed conference call will cause an automatic selection of the CONFERENCE STATUS display. The CONFERENCE STATUS display will remain on the A/G panel until all calls (more than 5) have been completed, when it may then be deselected by touching either the 'STATUS' area, or it may automatically be deselected by terminating the position's participation in the conference call.

Conference calls can be terminated by (1) touching 'RLSE'; or (2) touching 'CONF' when it is selected.

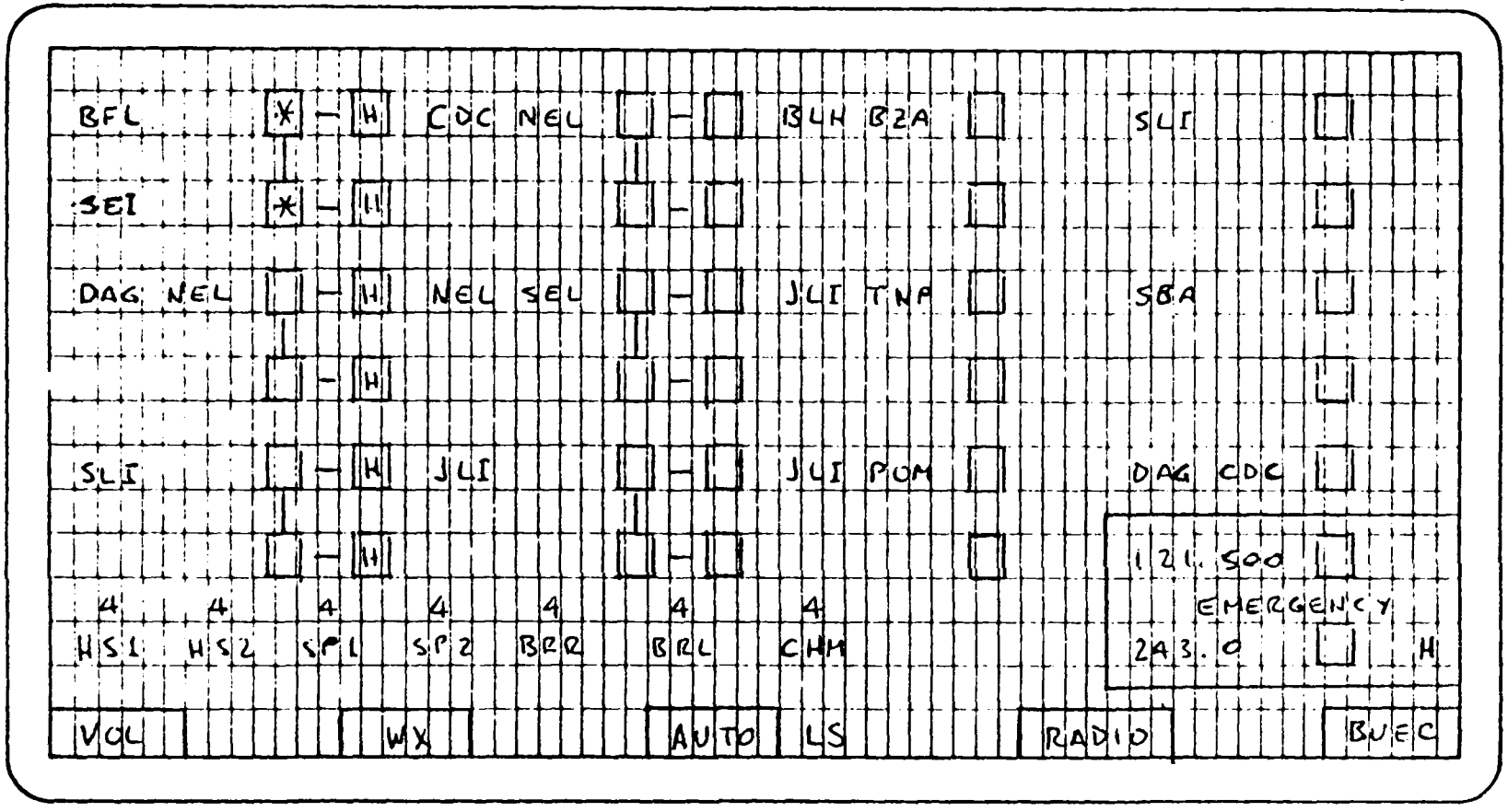
VSCS DISPLAY ALTERNATIVE: A/G PANEL (RADIO)

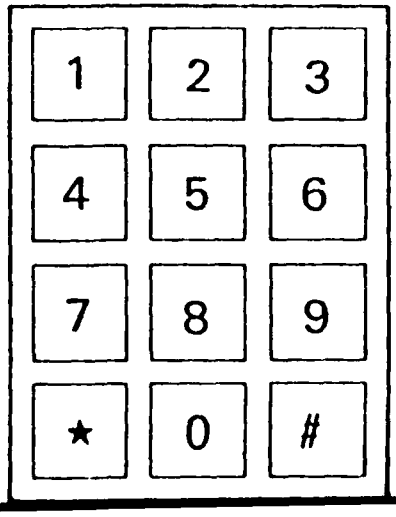




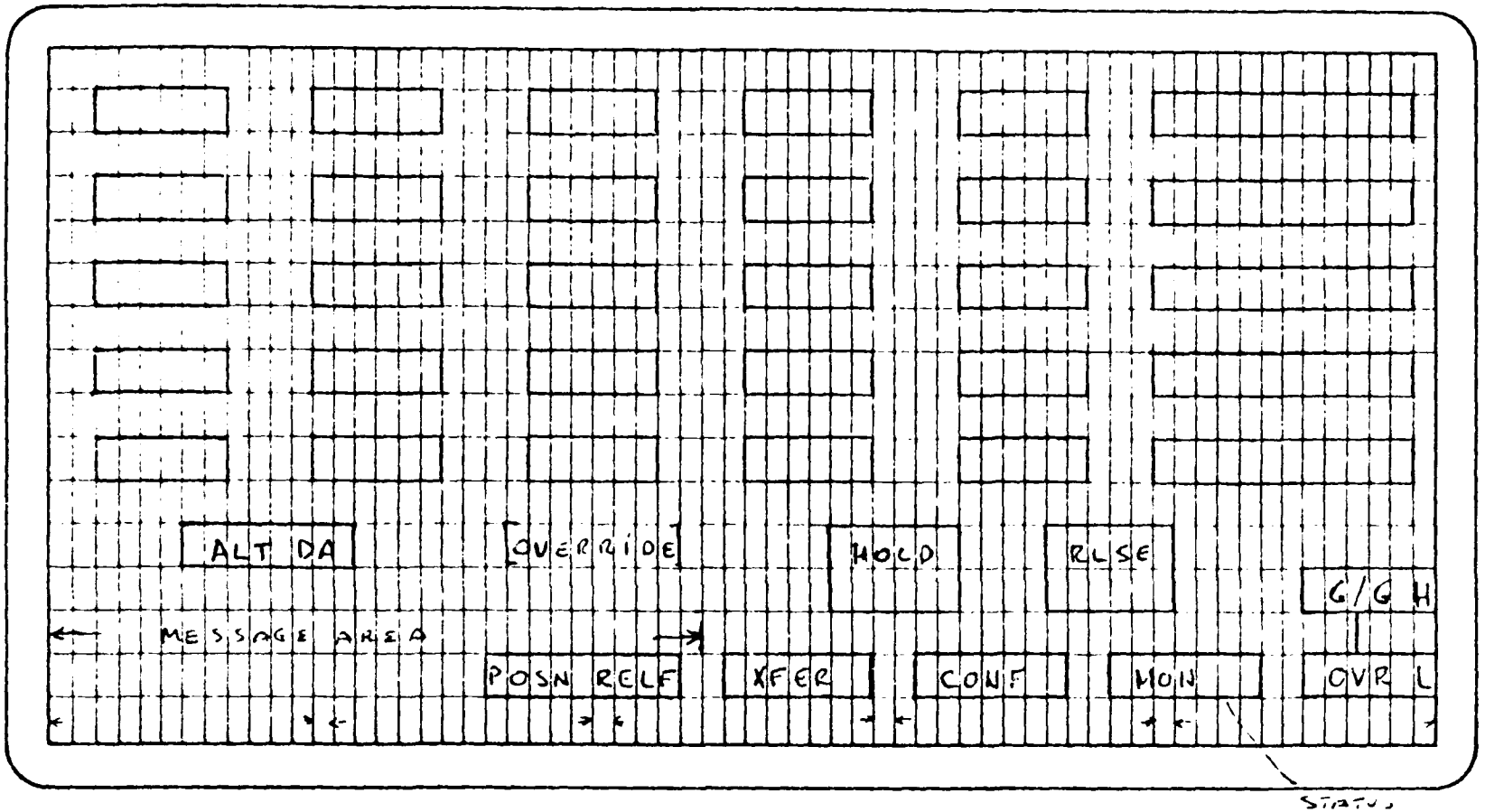
SHEET 1.

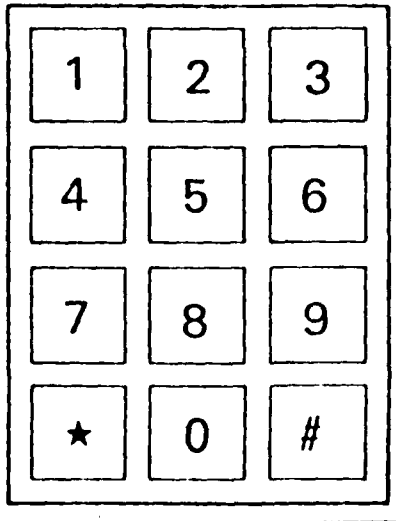
VSCS DISPLAY ALTERNATIVE: A/C PANEL (SIZES)



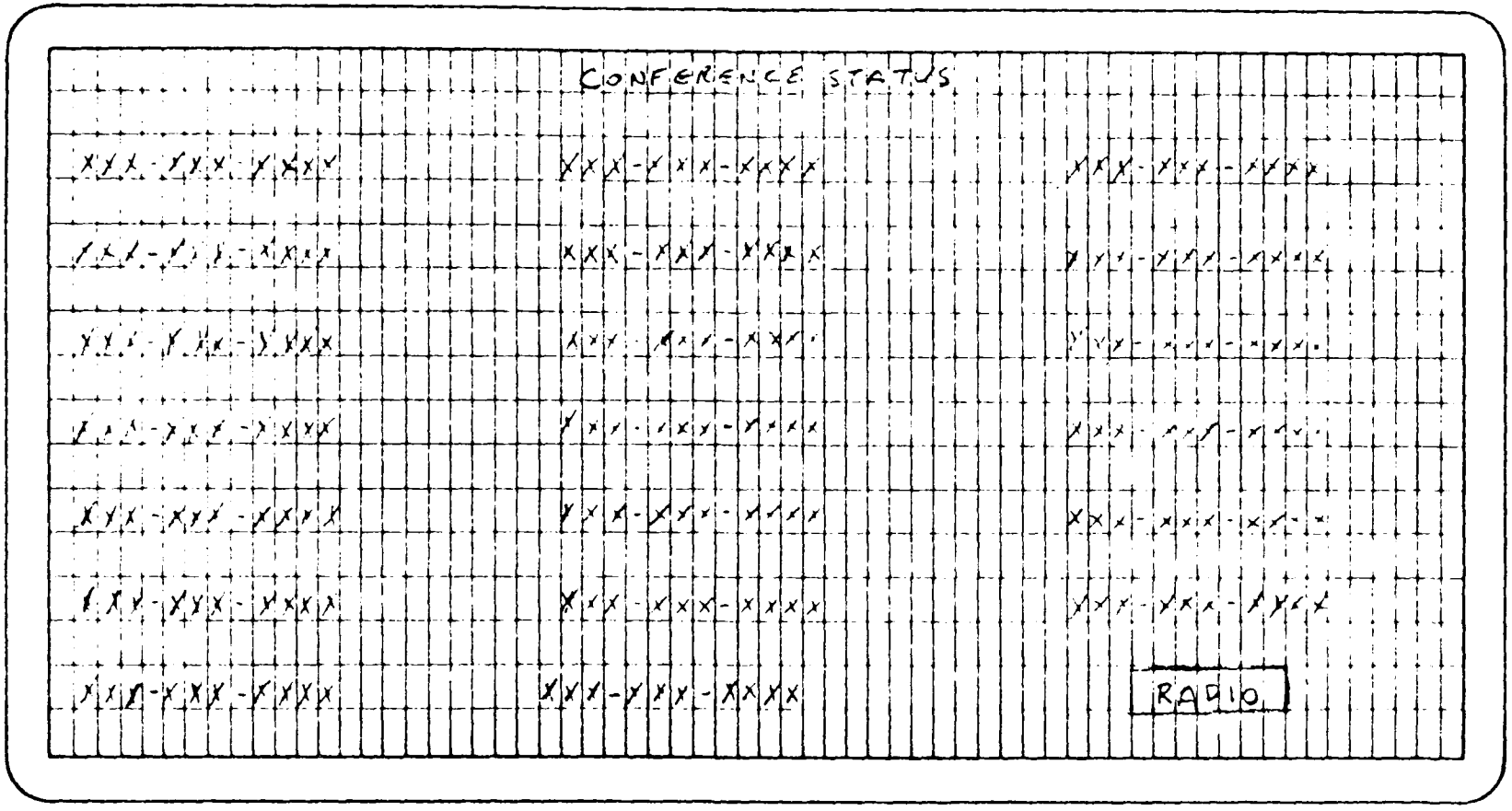


VSCS DISPLAY ALTERNATIVE: G/G PANEL



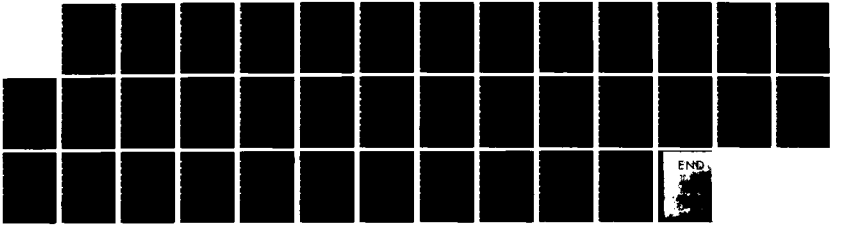


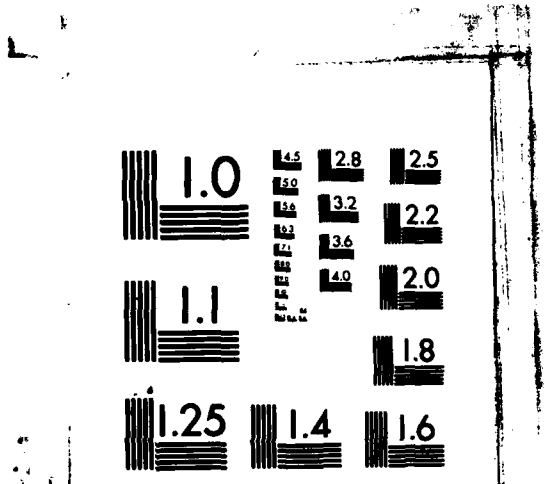
VSCS DISPLAY ALTERNATIVE:



AD-A140 825 ALTERNATIVE VOICE SWITCHING AND CONTROL SYSTEM DISPLAY PANEL FORMAT SIMUL..(U) JET PROPULSION LAB PASADENA CA M L SLONSKI ET AL. FEB 84 JPL-D-1371 DOT/FAA/PM-84/6 2/2

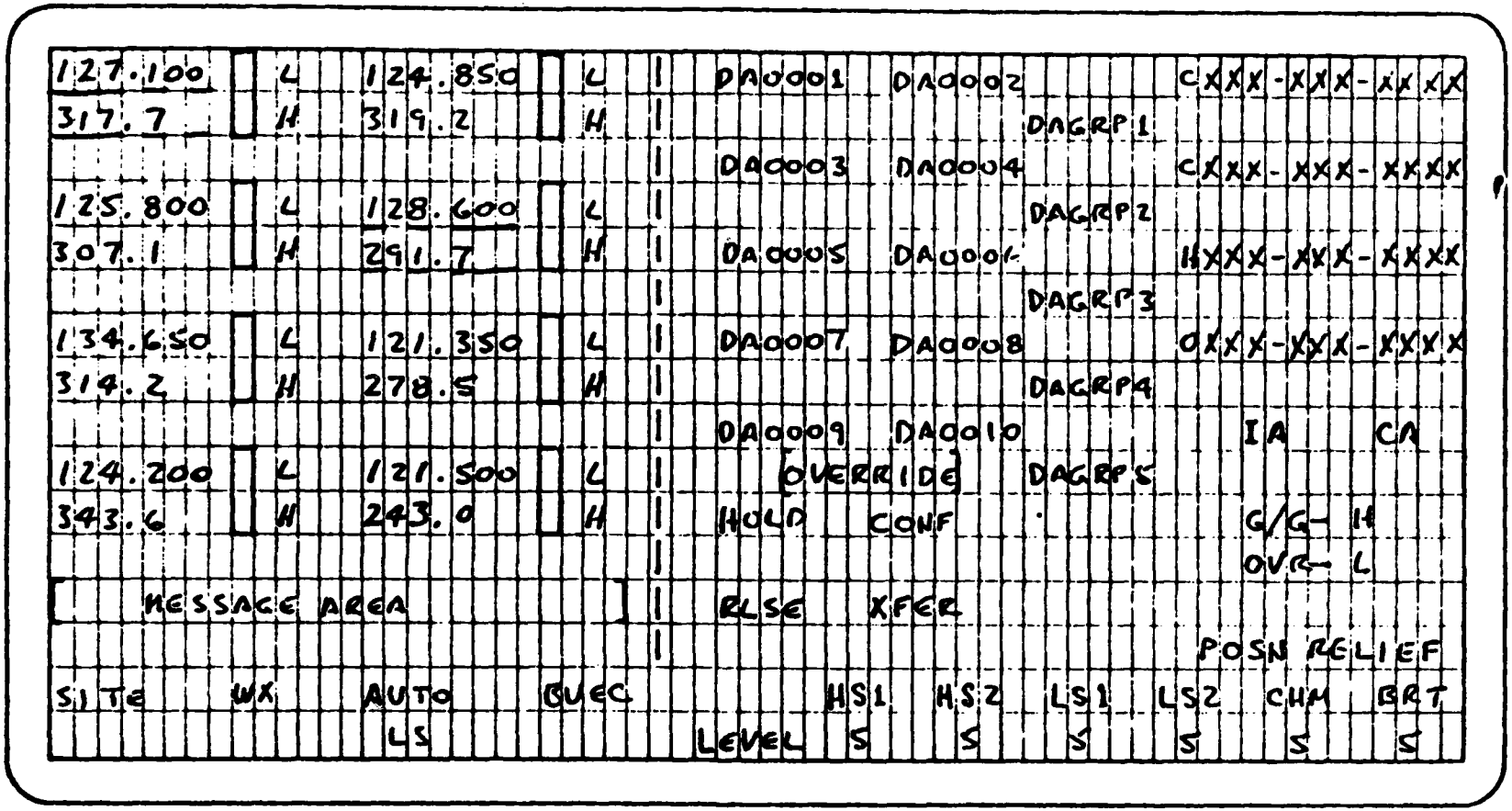
UNCLASSIFIED F/G 17/2 NL





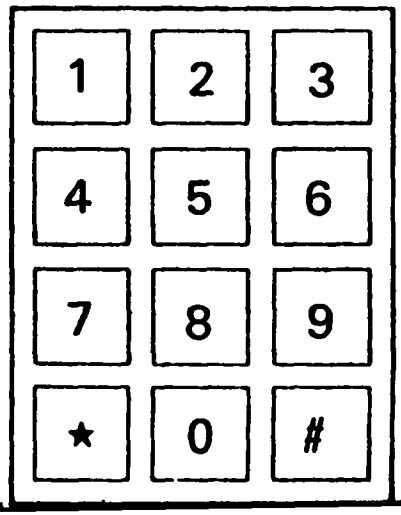
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

VSCS DISPLAY ALTERNATIVE:



① FUNCTIONS SAME AS ALTERNATIVE I.

② KEYPAD POSITION OPTIONAL ON EITHER RIGHT OR LEFT SIDE (OPERATOR SELECT)



APPENDIX E

EVALUATION FORMS

NAME _____

RATING OF FUNCTIONS AND FEATURES

Following is the list of functions and features that you will be evaluating for each alternative. You will be evaluating these functions in terms of ease of execution and observing status. Some functions are used more frequently than others and will be more important to the effective performance of your job. For that reason, please rate how important you think each function is in terms of how often you have to use it and how critical it is to access the function immediately.

1. Set-Up Functions

How important are the [redacted] following set-up functions to performing your job:

	VERY IMPORTANT (5)	QUITE IMPORTANT (4)	MODERATELY IMPORTANT (3)	NOT VERY IMPORTANT (2)	NOT AT ALL IMPORTANT (1)
POSITION RELIEF					
ROUTING OF VOICE (A/G, G/G, AND OVERRIDE)					
VOLUME CONTROL (HEADSETS, LOUDSPEAKERS, CHIME)					
DISPLAY BRIGHTNESS CONTROL					

2. Air-to-Ground Functions

How important are the [redacted] following air-to-ground functions to performing your job?

	VERY IMPORTANT (5)	QUITE IMPORTANT (4)	MODERATELY IMPORTANT (3)	NOT VERY IMPORTANT (2)	NOT AT ALL IMPORTANT (1)
TRANSMIT					
- ENABLE					
- SELECT MAIN/STANDBY					
[redacted]					
RECEIVE					
- ENABLE					
- SELECT MAIN/STANDBY					
- ROUTE VOICE TO HEADSET OR LOUDSPEAKER					
SITE SELECTION					
BUEC					
EMERGENCY FREQUENCIES					
WEATHER DISSEMINATION					
AUTOMATIC TRANSFER TO LOUDSPEAKER					

3. Ground-to-Ground Functions

How important are the [redacted] following ground-to-ground functions to performing your job?

	VERY IMPORTANT (5)	QUITE IMPORTANT (4)	MODERATELY IMPORTANT (3)	NOT VERY IMPORTANT (2)	NOT AT ALL IMPORTANT (1)
DIRECT ACCESS CALLS					
- OVERRIDE					
- NON-OVERRIDE					
INDIRECT ACCESS CALLS					
COMMON ANSWER QUEUE CALL SELECTION					
RELEASE					
HOLD					
TRANSFER					
MONITORING					
CONFERENCE					

NAME _____

EVALUATION FORM FOR ALTERNATIVE 1

NAME _____

EVALUATION FORM FOR ALTERNATIVE 2

NAME _____

EVALUATION FORM FOR ALTERNATIVE 3

I. SET UP

The demonstration of the set up functions will proceed as follows:

(1) One frequency pair enabled;
MAIN transmitters and receivers selected
(2) Initiate position relief recording
(3) Assign A/G frequency pair to headset or loudspeaker
(4) Assign automatic transfer of A/G voice to loudspeaker if G/G active
(5) Assign G/G to headset or loudspeaker
(6) Assign G/G override to headset or loudspeaker
(7) Adjust volume and brightness levels
(8) Terminate position relief recording

1. For each of the following set-up functions that have just been demonstrated please rate how adequate you think each was in terms of using the function to perform your job.

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
POSITION RELIEF							
ROUTING OF VOICE (A/G, (G/G AND OVERRIDE)							
VOLUME CONTROL (HEAD-SETS, LOUDSPEAKERS, CHIME)							
DISPLAY BRIGHTNESS CONTROL							

2. For each function marked "TOTALLY UNACCEPTABLE" state your reason.

_____

_____

_____

3. Did the functions demonstrated seem easy to use?

Yes, functions seemed easy to use . . . . . _____

No, functions did not seem easy to use . . _____

3a. If NO, the functions did not seem easy to use, why not: Was it because

	Yes	No
a. There were too many actions or steps involved	___	___
b. The progressions were not logical . . .	___	___
c. The status indicators were not easy to understand	___	___

d. Other, please list

_____

_____

_____

_____

4. Comments

_____

_____

_____

_____

II. AIR-TO-GROUND

The demonstration of the air-to-ground functions will proceed as follows:

(1) Transmit A/G voice
(2) Enable a transmitter/receiver pair
(3) Select STBY VHF transmitter
(4) Select STBY VHF receiver
(5) Transmit A/G voice
(6) Receive A/G voice
(7) A/G voice transmission on unselected transmitter
(8) Change transmitter/receiver site
(9) Change A/G voice from headset to loudspeaker
(10) Turn off a transmitter
(11) Turn off a receiver
(12) Select BUEC for a frequency
(13) Transmit A/G
(14) De-select BUEC
(15) Select VHF emergency frequency
(16) Select UHF emergency frequency
(17) Transmit on emergency frequencies
(18) De-select emergency frequencies
(19) Initiate transmission of weather recording
(20) Automatic transfer of A/G voice to loudspeaker

1. For each of the following air-to-ground functions that have just been demonstrated please rate how adequate you think each was in terms of using the function to perform your job.

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPTABLE
TRANSMIT							
ENABLE							
SELECT MAIN/STANDBY							
RECEIVE							
ENABLE							
SELECT MAIN/STANDBY							
ROUTE VOICE TO HEADSET OR LOUDSPEAKER							
SITE SELECTION							
BUEC							
EMERGENCY FREQUENCIES							
WEATHER DISSEMINATION							
AUTOMATIC TRANSFER TO LOUDSPEAKER							

2. For each function marked "TOTALLY UNACCEPTABLE" state your reason.

_____

_____

_____

_____

3. Did the air-to-ground functions demonstrated seem easy to use?

Yes, functions seemed easy to use . . . . . _____

No, functions did not seem easy to use . . _____

3a. If NO, the functions did not seem easy to use, why not? Was it because

	Yes	No
a. There were too many actions or steps involved	___	___
b. The progressions were not logical . . .	___	___
c. The status indicators were not easy to understand	___	___

d. Other, please list

_____
_____
_____
_____

4. Comments

_____
_____
_____
_____

III. GROUND-TO-GROUND

The demonstration of the ground-to-ground functions will proceed as follows:

(1) Initiate a DA call
(2) Terminate DA call with 'RLSE'
(3) Initiate DA override call
(4) Terminate DA override call by initiating another DA call
(5) Terminate DA call
(6) Receive a DA call
(7) Hold DA
(8) Resume DA
(9) Terminate DA call by answering another incoming DA call
(10) Initiate DA call on alternate page
(11) Receive a DA override call
(12) Receive a second DA override call
(13) DA override calls terminated
(14) Initiate an IA call
(15) Terminate an IA call with 'RLSE'
(16) Initiate an IA call
(17) Receive an IA call
(18) Terminate IA call by answering an incoming IA call
(19) Place an IA call on hold
(20) Resume a held IA call
(21) Terminate an IA call
(22) Initiate IA call with IA keypad
(23) Transfer call
(24) Initiate monitoring
(25) Terminate monitoring
(26) Initiate a conference call
(27) Terminate participation in a conference call

1. For each of the following ground-to-ground functions that have just been demonstrated please rate how adequate you think each was in terms of using the function to perform your job.

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
DIRECT ACCESS CALLS							
- OVERRIDE							
- NON-OVERRIDE							
INDIRECT ACCESS CALLS							
COMMON ANSWER QUEUE CALL SELECTION							
RELEASE							
HOLD							
TRANSFER							
MONITORING							
CONFERENCE							

2. For each function marked "TOTALLY UNACCEPTABLE" state your reason

_____

_____

_____

_____

3. Did the ground-to-ground functions demonstrated seem easy to use?

Yes, functions seemed easy to use . . . . . _____

No, functions did not seem easy to use . . _____

3a. If NO, the functions did not seem easy to use, why not: Was it because

	Yes	No
a. There were too many actions or steps involved	___	___
b. The progressions were not logical . . .	___	___
c. The status indicators were not easy to understand	___	___

d. Other, please list

_____
_____
_____
_____

4. Did the functions associated with DA calls seem easy to use:

Yes, DA functions seemed easy to use . . . . . _____

No, DA functions did not seem easy to use . . _____

4a. If NO, the DA functions did not seem easy to use, why not?

_____
_____
_____
_____

5. Did the functions associated with IA calls seem easy to use?

Yes, IA functions seemed easy to use . . . . . _____

No, IA functions did not seem easy to use . . _____

5a. If NO, the IA functions did not seem easy to use, why not?

_____
_____
_____
_____

6. Comments

_____
_____
_____
_____

IV. GENERAL QUESTIONS

The following questions pertain to the entire display and all the functions.

1. Overall, was the arrangement of the display easy to understand?

   Yes, the arrangement of the display was easy to understand . . . . . _____

   No, the arrangement of the display was *not* easy to understand . . . . . _____

1a. If NO, the arrangement of the display was not easy to understand, what was wrong with it?

_____

_____

_____

2. Overall, were the sequences required to operate the functions logical?

   Yes, the sequences were logical . . . . . _____

   No, the sequences were not logical . . . . _____

2a. If NO, the sequences were not logical, what was wrong with them?

_____

_____

_____

3. Were the status indicators discernible?

Yes, status indicators were discernible . . _____

No, status indicators were not discernible . . . . . _____

3a. If NO, the status indicators were not discernible, what was wrong with them?

_____

_____

_____

_____

4. When an action was initiated, was the response feedback sufficient to confirm the action?

Yes, feedback was sufficient . . . . . _____

NO, feedback was not sufficient . . . . . _____

4a. If NO, the feedback was not sufficient, what was wrong with it?

_____

_____

_____

_____

5. Do you have any other comments?

WEIGHTING MATRICES

SET UP FUNCTIONS

	VERY IMPORTANT (5)	QUITE IMPORTANT (4)	MODERATELY IMPORTANT (3)	NOT VERY IMPORTANT (2)	NOT AT ALL IMPORTANT (1)
POSITION RELIEF	3	2	2	1	1
ROUTING OF VOICE (A/G, G/G, AND OVERRIDE)	7	1		1	
VOLUME CONTROL (HEADSETS, LOUDSPEAKERS, CHIME)		4	5		
DISPLAY BRIGHTNESS CONTROL		2	4	3	

The numbers indicate the number of individuals selecting the specific weight value for the specific function.

GROUND-TO-GROUND FUNCTIONS

	VERY IMPORTANT (5)	QUITE IMPORTANT (4)	MODERATELY IMPORTANT (3)	NOT VERY IMPORTANT (2)	NOT AT ALL IMPORTANT (1)
DIRECT ACCESS CALLS	8	1			
- OVERRIDE	9				
- NON-OVERRIDE	2	5	1	1	
INDIRECT ACCESS CALLS	2	4	2	1	
COMMON ANSWER QUEUE CALL SELECTION		1	5	2	1
RELEASE	6	3			
HOLD		2	2	2	3
TRANSFER			5	1	3
MONITORING	4	3		2	
CONFERENCE		1	3	4	1

The numbers indicate the number of individuals selecting the specific weight value for the specific function.

AIR-TO-GROUND FUNCTIONS

	VERY IMPORTANT (5)	QUITE IMPORTANT (4)	MODERATELY IMPORTANT (3)	NOT VERY IMPORTANT (2)	NOT AT ALL IMPORTANT (1)
TRANSMIT	8	1			
- ENABLE	6	2			1
- SELECT MAIN/STANDBY	2	5	1	1	
RECEIVE	8	1			
- ENABLE	6	2			1
- SELECT MAIN/STANDBY	2	4	3		
- ROUTE VOICE TO HEADSET OR LOUDSPEAKER	1	2	5	1	
SITE SELECTION	1	4	1	2	1
DUBC	3	2	2	1	1
EMERGENCY FREQUENCIES	1	4	2	2	
WEATHER DISSEMINATION			6	2	1
AUTOMATIC TRANSFER TO LOUDSPEAKER	5	3	1		

The numbers indicate the number of individuals selecting the specific weight value for the specific function.

OVERALL GROUP AVERAGES - ALTERNATIVE 1

		Min Value	Max Value	$\bar{X}$	$\sigma_{\bar{X}}$
Set-up	1	4	25	14.8	6.7
	2	8	25	17.6	4.9
	3	8	16	10.4	3.1
	4	6	15	10.4	3.5
G/G	1	0[2]	25	15.6	9.5
	2	10	25	18.3	5.0
	3	8	25	14.6	6.4
	4	8	20	15.2	3.7
	5	3	16	11	3.8
	6	12	25	22	4.9
	7	3	20	10.6	6.4
	8	2	15	7	4.5
	9	4	25	13.9	7.1
	10	2	15	9	4.4
A/G	1	0[1]	25	18.3	7.9
	2	3	25	19.3	7.3
	3	8	25	16.5	5.2
	4	0[1]	25	18.3	7.9
	5	3	25	19.3	7.3
	6	9	25	16.6	5.0
	7	10	15	13.4	2.1
	8	0[1]	20	8	6.7
	9	3	20	8.3	5.8
	10	5	16	10.4	3.7
	11	4	15	11.1	3.6
	12	10	25	17.3	4.9
				$\Sigma\bar{X}$ = 365.2	

OVERALL GROUP AVERAGES - ALTERNATIVE 2

		Min Value	Max Value	$\bar{X}$	$\sigma_{\bar{X}}$
Set-up	1	0[1]	25	10.4	7.7
	2	5	20	12	6.8
	3	4	15	9.6	3.8
	4	4	20	9.4	5.4
G/G	1	0[1]	20	12.4	7.9
	2	5	20	15.6	5.8
	3	6	20	13.6	5.3
	4	0[1]	20	13.6	6.0
	5	0[1]	9	5.7	3.2
	6	12	25	19.8	4.0
	7	3	20	9.1	5.6
	8	2	15	7.8	4.1
	9	6	20	13.1	4.9
	10	3	15	8.3	3.5
A/G	1	0[2]	15	10.2	6.2
	2	0[2]	15	8.6	6.2
	3	0	15	7.3	4.0
	4	0[2]	15	10.2	6.2
	5	0[2]	15	8.3	6.4
	6	0[1]	15	7.4	4.1
	7	6	12	8.6	2.4
	8	2	20	9.6	6.0
	9	0[2]	20	7.4	6.4
	10	6	20	13.2	4.3
	11	3	15	9.6	4.2
	12	10	20	16.3	3.8
				$\Sigma\bar{X}$ = 277.1	

OVERALL GROUP AVERAGES - ALTERNATIVE 3

		Min Value	Max Value	$\bar{X}$	$\sigma_{\bar{X}}$
Set-up	1	4	25	16	6.8
	2	5	25	17.9	7.3
	3	0[1]	20	13	5.9
	4	4	20	13	5.5
G/G	1	16	25	22.3	3.4
	2	20	25	23.3	2.5
	3	10	25	17.3	5.2
	4	9	25	16.8	5.1
	5	5	20	12.3	4.4
	6	10	25	19.2	5.8
	7	3	20	10.4	6.0
	8	2	15	8.1	5.0
	9	6	20	12	4.2
	10	4	15	8.9	4.3
A/G	1	16	25	21.2	3.1
	2	4	25	18	7.1
	3	8	25	14.7	7.2
	4	16	25	21.2	3.1
	5	4	25	18	7.1
	6	9	20	17	4.8
	7	9	20	13.9	3.4
	8	4	20	12.4	5.5
	9	0[2]	20	8	7.1
	10	6	16	12	4.2
	11	4	15	10.3	3.0
	12	0[1]	20	15	6.2
				$\Sigma\bar{X}$ = 392.2	

TERMINAL AND EN ROUTE GROUP AVERAGES - ALTERNATIVE 1

		Terminal $\bar{X}$	En Route $\bar{X}$
Set-up	1	16	13.8
	2	21.3	14.6
	3	10	10.8
	4	9.5	11.2
G/G	1	22.5	10**
	2	22.5	15
	3	20.3	10
	4	14.8	15.6
	5	9.8	12
	6	23.8	20.6
	7	8.8	12
	8	7	7
	9	14	13.8
	10	7.7	10
A/G	1	22	16*
	2	22	17.6
	3	20	14.4
	4	22	16*
	5	22	17.6
	6	20	14.6
	7	13.3	13.4
	8	9.7	7*
	9	6.7	9.2
	10	12	9.4
	11	9.3	12.2
	12	14	19.2
		401	343

*Totally unacceptable

TERMINAL AND EN ROUTE GROUP AVERAGES - ALTERNATIVE 2

		Terminal $\bar{X}$	En Route $\bar{X}$
Set-up	1	15.3	10.6*
	2	16.3	12.6
	3	8.3	10.6
	4	8.5	10.2
G/G	1	18.8	11.4*
	2	18.8	15
	3	17	10.8
	4	13.8	13.4*
	5	6.3	5.2*
	6	20	19.6
	7	7.8	8.2
	8	7.8	7.8
	9	14.8	11.8
	10	7	9.4
A/G	1	9.3*	11*
	2	8*	7*
	3	9*	7.6
	4	9.3*	11*
	5	8*	8.6*
	6	7*	7.8
	7	9	8.2
	8	10	9.2
	9	11	6.6**
	10	16.8	10.4
	11	9.3	9.8
	12	16.3	16.4
		303.5	270.3

*Totally unacceptable

TERMINAL AND EN ROUTE GROUP AVERAGES - ALTERNATIVE 3

		Terminal $\bar{X}$	En Route $\bar{X}$
Set-up	1	16	16
	2	21.3	15.2
	3	12.8	13.2*
	4	11.5	14.2
G/G	1	23.8	21.2
	2	23.8	23
	3	19.3	15.8
	4	15.3	18
	5	11	13.4
	6	19	19.4
	7	9.5	11.2
	8	10.3	6.4
	9	12.3	11.8
	10	7.8	9.8
A/G	1	21.5	21
	2	21.5	15.2
	3	20	14.4
	4	21.5	21
	5	21.5	15.2
	6	20	14.6
	7	13.5	14.2
	8	9	15.2
	9	8.5	7.6**
	10	15	9.6
	11	8.8	11.6
	12	12 *	17.4
		406.5	385.4

*Totally unacceptable

SET-UP FUNCTIONS

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
POSITION RELIEF							
ROUTING OF VOICE (A/G, (G/G AND OVERRIDE)			NO PROBLEM AREAS				
VOLUME CONTROL (HEAD-SETS, LOUDSPEAKERS, CHIME)							
DISPLAY BRIGHTNESS CONTROL							

GROUND-TO-GROUND FUNCTIONS

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
DIRECT ACCESS CALLS							XX
- OVERRIDE				X			
- NON-OVERRIDE				X			
INDIRECT ACCESS CALLS							
COMMON ANSWER QUEUE CALL SELECTION							
RELEASE							
HOLD							
TRANSFER							
MONITORING					X		
CONFERENCE							

AIR-TO-GROUND FUNCTIONS

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
TRANSMIT							X
ENABLE							
SELECT MAIN/STANDBY							
RECEIVE							X
ENABLE							
SELECT MAIN/STANDBY							
ROUTE VOICE TO HEAD-SET OR LOUDSPEAKER							
SITE SELECTION							X
SUBC							X
EMERGENCY FREQUENCIES					X		
WEATHER DISSEMINATION							
AUTOMATIC TRANSFER TO LOUDSPEAKER				X			

Alternative 1 - Problem Areas

SET-UP FUNCTIONS

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
POSITION RELIEF							X
ROUTING OF VOICE (A/G, (G/G AND OVERRIDE)				X	X		
VOLUME CONTROL (HEAD-SETS, LOUDSPEAKERS, CHIME)				XX	X		
DISPLAY BRIGHTNESS CONTROL							

GROUND-TO-GROUND FUNCTIONS

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
DIRECT ACCESS CALLS				X			X
- OVERRIDE				XX	X		
- NON-OVERRIDE				XX			
INDIRECT ACCESS CALLS					X		X
COMMON ANSWER QUEUE CALL SELECTION					X		X
RELEASE							
HOLD							
TRANSFER							
MONITORING					X		
CONFERENCE							

AIR-TO-GROUND FUNCTIONS

	VERY ADEQUATE (5)	QUITE ADEQUATE (4)	MODERATELY ADEQUATE (3)	NOT VERY ADEQUATE (2)	NOT AT ALL ADEQUATE (1)		TOTALLY UNACCEPT-ABLE
TRANSMIT				XX			XX
ENABLE				X	X		XX
SELECT MAIN/STANDBY				XXX	X		X
RECEIVE				XX			XX
ENABLE				X	X		XX
SELECT MAIN/STANDBY				XXX	X		X
ROUTE VOICE TO HEAD-SET OR LOUDSPEAKER				XX			
SITE SELECTION				X	X		
DUBC					X		XX
EMERGENCY FREQUENCIES							
WEATHER DISSEMINATION							
AUTOMATIC TRANSFER TO LOUDSPEAKER				X			

Alternative 2 - Problem Areas

TRW Modifications
Alternative 3 changes

MODIFIED ALTERNATIVE

1. Display Image

a. Eliminate volume control

(1) (See attached diagrams) The VOL touch area and its associated functions are to be eliminated.

b. Change brightness control

(1) A new touch area, BRITE, will be established on each touch panel. Its will function as follows:

(a) OFF, then touched: BRITE will reverse video. The message area (on the same panel only) will be activated for touch The message area will appear as:

1 - 2 - 3 - 4 - 5 - 6 - 7 - 8

with the current selected brightness level in reverse video.

Touching one of the numbers will cause that number to go to reverse video, and any other previously selected numbers will return to normal video.

(b) REVERSE VIDEO, then touched: BRITE will return to normal, and the message area will CLEAR

c. Regroup G/G functions

See attached diagrams

d. Monitor display should display a monitor group

(1) The MON function will now perform as follows:

(a) OFF, the touched: MON goes to reverse video. The rightmost two columns of DA designators "page" to a new set of designators, which will be classmarked as monitor only.

Touching one of the monitor designators will cause it to go to reverse video when the monitor connection has been made.

Touching an already selected monitor designator will cause it to be deselected from monitoring; its display will return to normal.

(2) MON reverse video, then touched: MON returns to normal video; Monitor "page" reverts to original set of DA designators; All monitoring is terminated.

e. Add IA and RLSE to keypad

(1) Replace '*' and '#' symbols with 'IA' and 'RLSE', respectively. The two functions perform as follows:

(a) IA will always enable the keypad, and always initiate a new dialing sequence, concurrently terminating any active call. When touched/pushed, the IA touch area will REVERSE, and the IA key will light.

If a dialing sequence is not started within 10 seconds, the IA key will go OFF, the touch area NORMAL, and the keypad will be disabled.

(b) RLSE will always terminate the active call, and/or disable the keypad. The key will light for one second, the touch area will reverse for one second.

2. AIR-TO-GROUND

a. Keyed frequencies

Other PTT on any displayed frequency (except BUEC selections):
Xmtr indicator box goes SOLID reverse video (no flash)

Our PTT (except BUEC selections):
Xmtr indicator boxes FLUTTER on all selected frequencies

Incoming voice on unselected frequencies (except BUEC):
Rcvr indicator boxes SOLID reverse video (no flash)

Incoming voice on selected frequencies (except BUEC):
Rcvr indicator boxes FLUTTER

b. Xmtr/rcvr selection

Transmitter/receivers can be turned off individually.
Paired frequencies are still selected by a single touch.

c. Receive voice in frequency pairs

Incoming voice on a paired frequency will cause selected both rcvr indicator boxes for the pair to FLUTTER

d. Emergency frequencies

Emergency frequency transmitter/receiver selection will be the same as for "normal" unpaired frequencies. The indication of transmitter selection will differ in that the frequency number will also reverse.

Additional display/functional differences:

If there is incoming voice on an emergency frequency, and no xmtr has been selected, the rcvr indicator box will FLUTTER (as is usual). and the frequency number will FLASH until a transmitter has been selected within VSCS. When a xmtr is selected at another position, the frequency number will revert to normal. If a xmtr is selected

at this position, the frequency number will be steady reverse video.

If no voice is present on either incoming or outgoing on emergency for 1 minute, then the xmtrs will automatically deselect, and all displays revert to their previous state.

e. Display and allow changes to SITES only on selected frequencies; expand to more than two sites

(1) The SITES function will change to the following:

Touching an disabled(?) SITES area:
The SITES area goes to reverse video; all touch areas for the selected frequencies change function to site selection.

When any touch area of a selected frequency/frequency pair is touched, the word SITES appears below/between the frequency/ frequency pair, and the site designators appear in the A/G panel message area, with the message area enabled for touch, and selected sites in reverse video, e.g.,

BFL SEL NEL JLI TNP

Touching a site designator will toggle its state between selected/not selected, within the requirement that at least one site must be selected.

3. GROUND-TO-GROUND

a. Provide for the display of how an incoming DA call on another page is handled.

For an incoming DA call on the alternate (undisplayed) DA page, if the CA queue is full:
FLASH the 'ALT DA' box. When it is touched, rewrite the DA's with the alternate DA page, FLASH the incoming DA designator, and set the 'ALT DA' box back to normal.
else:
Place the FLASHING DA designator in the CA queue, handle as though it were an IA incoming call.

b. Remove the 'H' from adjacent to a held DA call; just WINK the DA designator. Delete capability to hold an override call.

c. Include transferring a call in the CA queue (incoming IA) to DA or IA

d. Voice calls demonstrate the use of a trunk by multiple users and require that all users know when the trunk is in use.
Three states exist for positions with access to the trunk;
(1) trunk-in-use; (2) trunk-in-use-connected; and
(3) trunk-in-use-calling.

Trunk-in-use-calling implies that one position has initiated the voice call, but no other position has yet answered.

Trunk-in-use-connected implies that this position has a voice connection on the trunk, i.e., this position has either made the voice call or has answered it, and can talk on the trunk. Trunk-in-use implies that other positions have voice connection on the trunk, but this position cannot talk on the trunk without answering or joining the trunk.

(1) Initiating a voice call

A voice call is initiated by touching a designated DA area or dialing an IA connection code.

The initiator of the voice call will have a FLUTTERING designator indicating trunk-in-use-connected. All other parties connected to the trunk (until somebody answers) will observe a FLASHING designator, indicating trunk-in-use-calling.

(2) Answering a voice call:

Touching the FLASHING voice call designator will answer the call. The designator will FLUTTER while the call is in progress.

If another position answers the voice call, the voice call designator at this position will go STEADY indicating trunk-in-use.

(3) Join-in a voice call:

Touching the STEADY (trunk-in-use) designator will connect this position to the voice call. The designator will change to FLUTTER (trunk-in-use-connected).

(4) Terminating/Disconnecting a voice call:

If the designator is FLUTTERING (trunk-in-use-connected), then a touch to the designator (or initiating another call) will cause the designator to change to STEADY (trunk-in-use).

When <u>all</u> trunk-in-use-connected positions have terminated their participation in the voice call, then the designators at all postions will go to NORMAL.

e. Provide for two types of outgoing DA override calls

(1) Type one does not require PTT and is immediately connected and enabled for voice (no change to current process)

(2) Type two requires PTT for voice. Voice is routed over G/G and any selected A/G voice transmissions are disabled until the DA override call is terminated.

f. Outgoing non-override calls that have no DA designator at the called position.

This type of call is handled from the calling position as is any other non-override DA call, except that the called party receives the call in that positions CA queue, and the caller receives a 'DAxx CALL PLACED IN CA QUEUE' in its G/G message area.

4. IA FUNCTIONS

A pseudo numbering scheme must be established to demonstrate the required IA functionality. A suggested scheme follows:

Outgoing calls (via IA keypad)

DA	IA - 0 - XX
IA	IA - 4XXX
	IA - 9 - XXX - XXXX
IA(O)	IA - 5XXX

Trunk access calls (via DA)

TA	DA - (msg) - XXX

Trunk access calls (via IA keypad)

TA	IA - 2XXX - (msg) - XXX

(msg :== 'TRUNK READY' in G/G message area)

Special functions

forwarding	IA - 31 - 0XX
end forwarding	IA - 31 - 000
transfer	IA - 32 - 4XXX
	IA - 32 - 9 - XXX - XXX
conference	IA - 33
posn relief	IA - 34
brightness	IA - 35 - X
	IA - 36 - X

5. UNDECIDED (but still in)

a. BUEC

No changes

b. CA queue

No changes, except as described in 3.a above

c. Conference Calls

Touching 'HOLD' while conference calls are enabled will disconnect the caller temporarily from the conference. 'CONF' will WINK while in hold. Any IA/DA calls received or initiated while CONF is on

hold will be 'normal'. The conference call is resumed by touching the winking 'CONF'.

6. EXTERNAL CONTROL

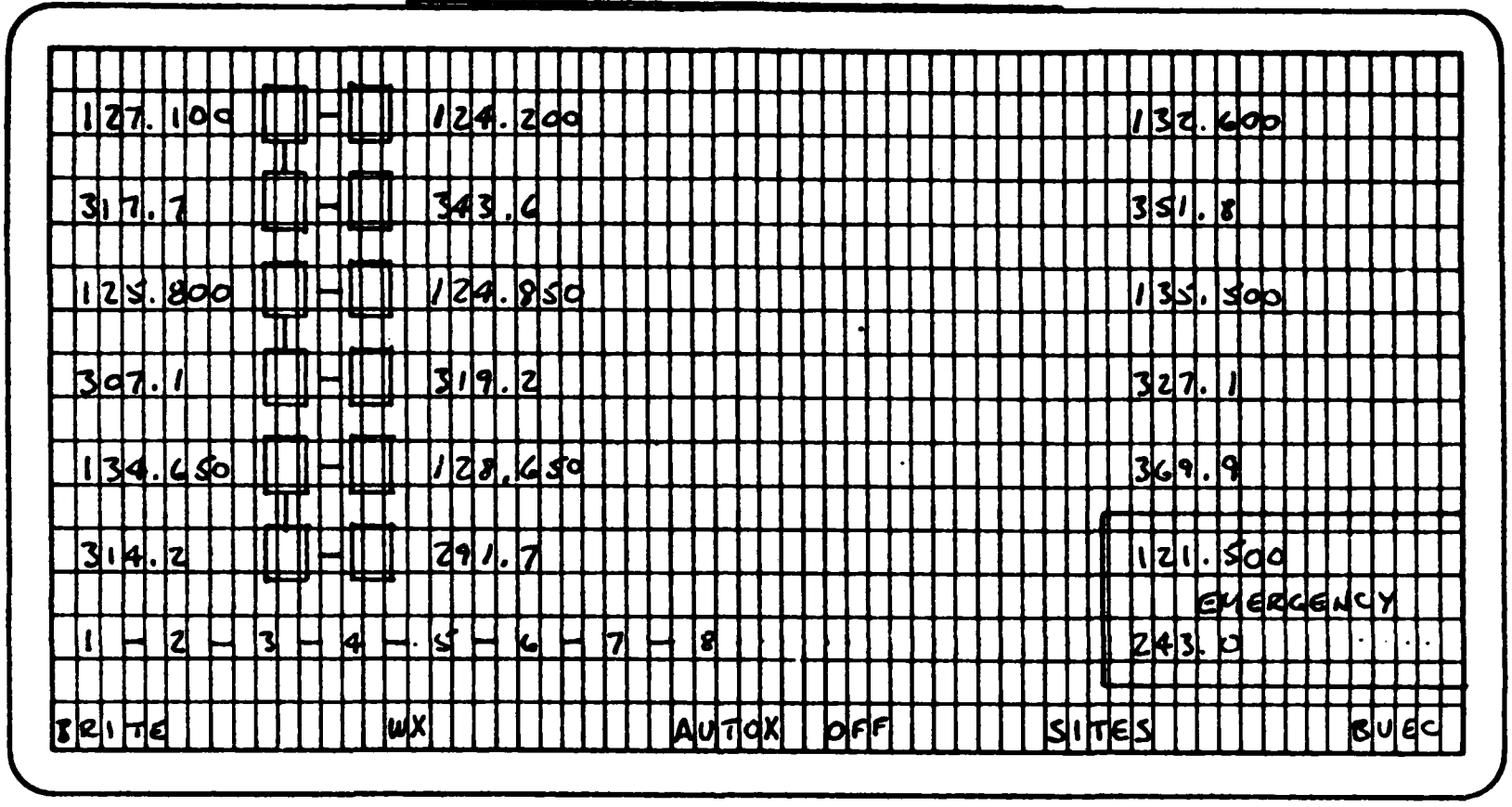
a. Air-to-ground

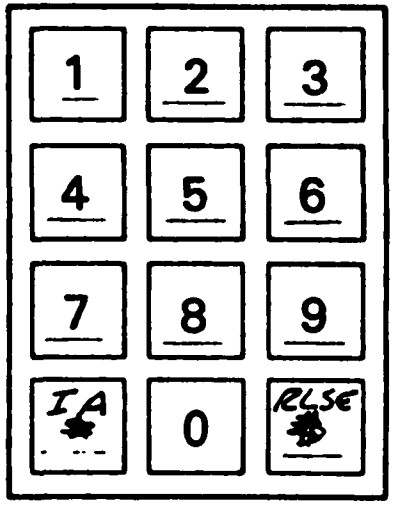
(1) Start/stop receive voice
(2) Start/stop PTT (this position)
(3) Start/stop PTT (another position)
(4) Start/stop PTT (another position) with PTT lockout (message in A/G message area: 'FREQ IN USE - PTT LOCKOUT')

b. Ground-to-ground

(1) Incoming DA (ring or override)
(2) Other position terminates DA call (ring or override)
(3) Incoming DA w/o DA designator
(4) Incoming IA calls (ring or override)
(5) Other position terminates IA call (ring or override)
(6) Outgoing IA calls answered
(7) Outgoing DA calls answered
(8) Incoming voice calls
(9) Another position answers a voice call
(10) Another position terminates connection to voice call

VSCS DISPLAY ALTERNATIVE:





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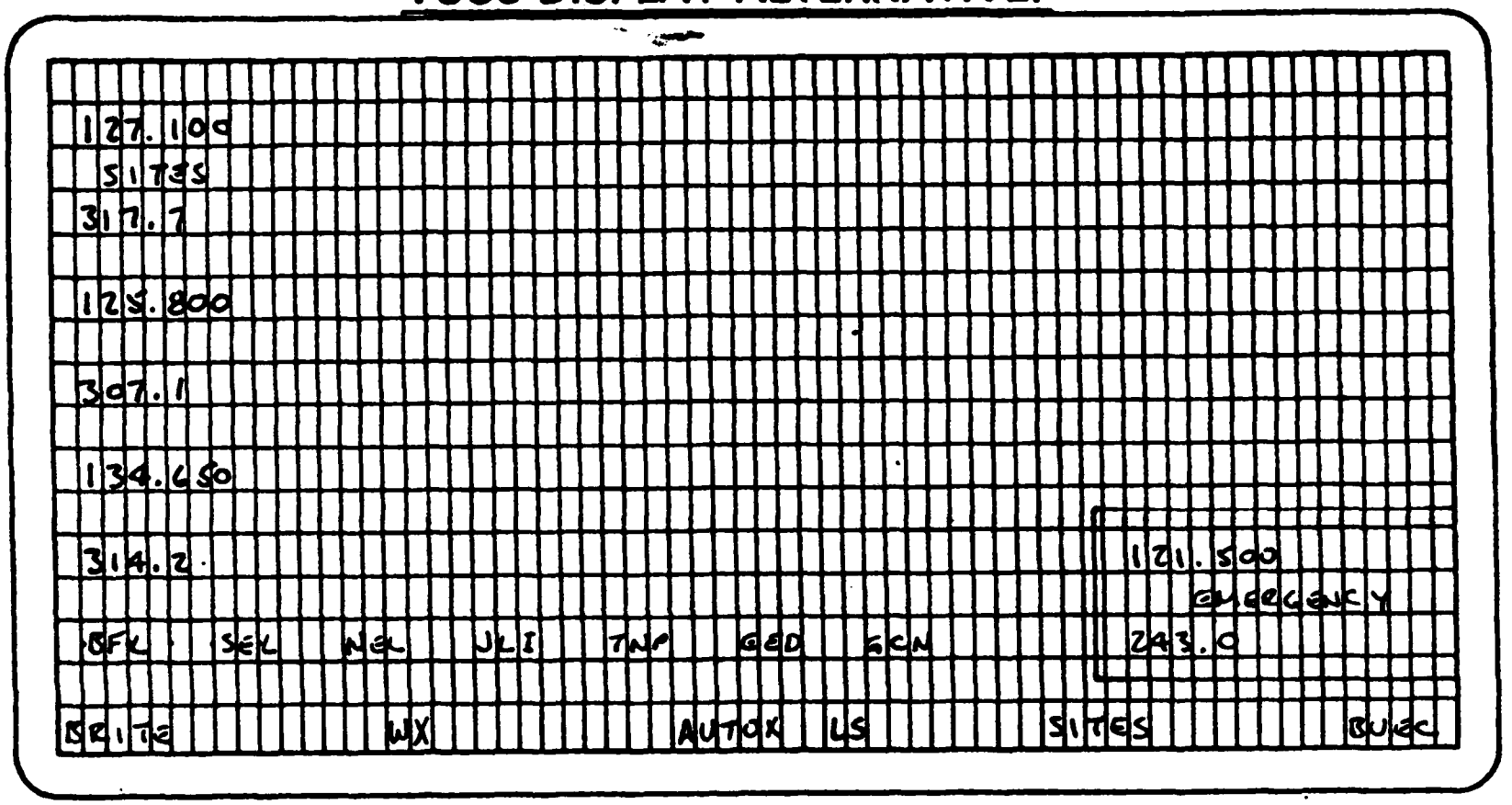

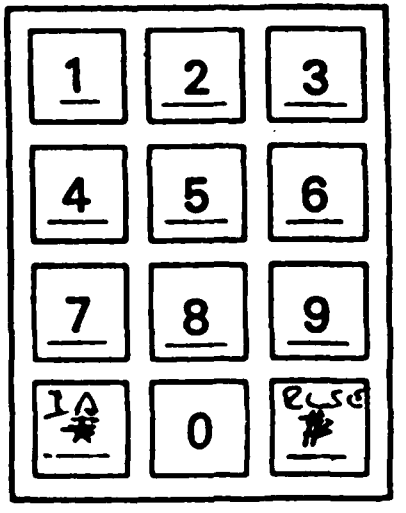

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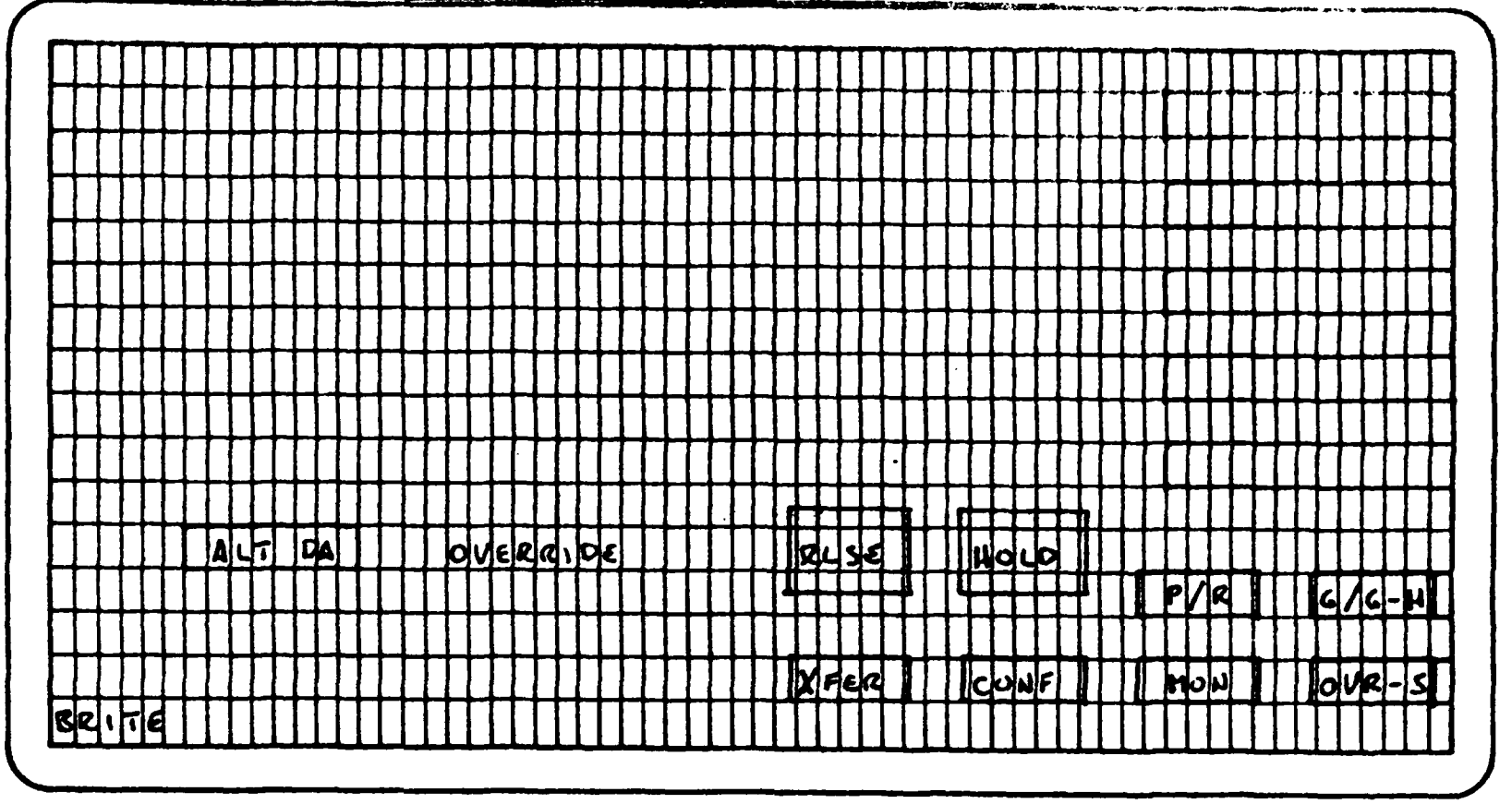

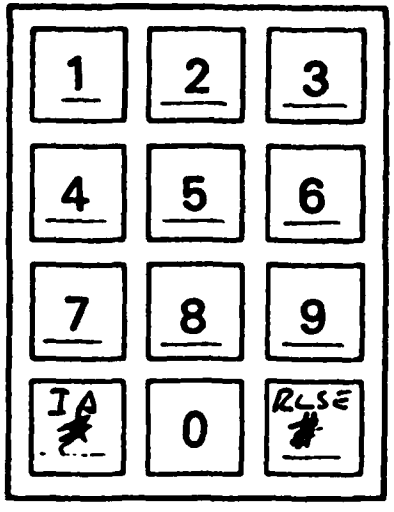

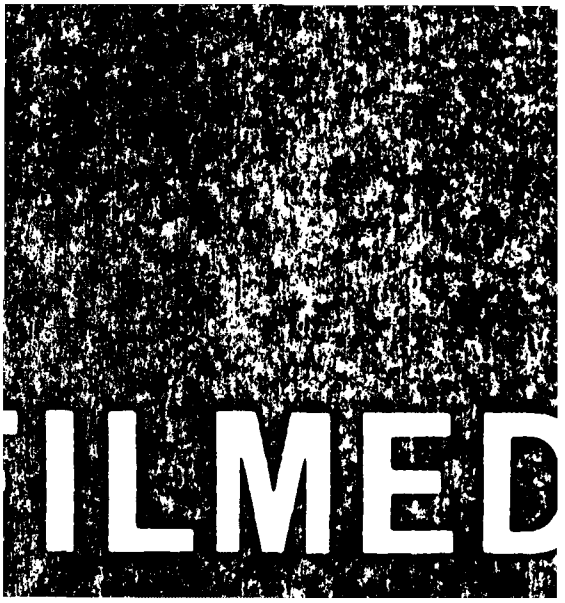
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